July 2002

FISH PASSAGE CENTER

2001 Annual Report

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FISH PASSAGE CENTER

ANNUAL REPORT

2001

This report responds to the Fish Passage Center annual reporting requirements to the Northwest Power Planning Council under its Columbia River Basin Fish and Wildlife Program, and the annual reporting requirements to the Bonneville Power Administration under its funding contracts which supported this work.

BPA PROJECT NO. 1994-033-00

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July 2002

Final

Fish Passage Center 2001 Annual Report

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Acknowledgments

We thank all the individuals, agencies, and organizations who contributed to the successful completion of the 2001 program.

We extend thanks to the hatchery release coordinators, managers, and staffs of all basin facilities for providing timely information on hatchery releases. We are indebted to the managers and staffs of Wells, Winthrop, Leavenworth, Priest Rapids, Rapid River, McCall, Dworshak, and Lookingglass hatcheries, all of whom supplied fish and logistical assistance for the marking program. We extend a special thanks to those who tagged fish with Passive Integrated Transponder (PIT) tags for the Smolt Monitoring Program (SMP). Fish marking was carried out by U.S. Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW), Nez Perce Tribe (NPT), and Washington Department of Fish and Wildlife (WDFW).

We appreciate the efforts of the field crews at each of the monitoring sites. Sampling and reporting were carried out by WDFW at Rock Island, Ice Harbor, McNary, Lower Monumental, and Lower Granite dams; by ODFW at Little Goose Dam and Grande Ronde River trap; by Pacific States Marine Fisheries Commission (PSMFC) at John Day and Bonneville dams; by Chelan County PUD at Rock Island Dam; by NPT at Imnaha River trap; and by IDFG at the traps on the Salmon and Snake rivers.

In addition to the aforementioned monitoring supported under the SMP, related activities by others, such as the fish transportation program supported by the U.S. Army Corps of Engineers (COE), provided valuable information at various monitoring sites. The COE also provided facilities and accommodations for smolt monitoring activities at their projects. This report was prepared by the Fish Passage Center (FPC) staff: Michele DeHart, Tom Berggren, Margaret Filardo, Larry Basham, David Benner, Henry Franzoni, Sergei Rasskazov, Jerry McCann, Deidre Wood, Chris McCarty and Dona Watson.

The project was funded by Bonneville Power Administration (BPA), under the Northwest Power Planning Council Fish and Wildlife Program, Section 303 (d) (1), BPA Project #1994-03300 and Research Action #1136 of Appendix H of the Biological Opinion as part of the activities necessary to implement NMFS Biological Opinon Reasonable and Prudent Alternatives (RPAs) 9.6.1.3.3, 9.6.1.3.4., and 9.6.1.4.6.

Executive Summary

Extremely poor water conditions within the Columbia River Basin along with extraordinary power market conditions created an exceptionally poor migration year for juvenile salmon and steelhead. Monthly 2001 precipitation at the Columbia above Grand Coulee, the Snake River above Ice Harbor, and the Columbia River above The Dalles was approximately 70% of average. As a result the 2001 January-July runoff volume at The Dalles was the second lowest in Columbia River recorded history. As a compounding factor to the near record low flows in 2001, California energy deregulation and the resulting volatile power market created a financial crisis for the Bonneville Power Administration (BPA). Power emergencies were first declared in the summer and winter of 2000 for brief periods of time. In February of 2001, and on April 3, the BPA declared a "power emergency" and suspended many of the Endangered Species Act (ESA) and Biological Opinion (Opinion) measures that addressed mainstem Columbia and Snake Rivers juvenile fish passage. The river and reservoir system was operated primarily for power generation. Power generation requirements in January through March coincidentally provided emergence and rearing flows for the Ives-Pierce Islands spawning area below Bonneville Dam.

In particular, flow and spill measures to protect juvenile downstream migrant salmon and steelhead were nearly totally suspended. Spring and summer flows were below the Opinion migration target at all sites. Maximum smolt transportation was implemented instead of the Opinion in-river juvenile passage measures. On May 16, the BPA Administrator decided to implement a limited spill for fish passage at Bonneville and The Dalles dams. On May 25, a limited spill program was added at McNary and John Day dams. Spill extended to July 15. Juvenile migrants, which passed McNary Dam after May 21, experienced a noticeable, improved survival, as a benefit of spill at John Day Dam. The suspension of Biological Opinion measures resulted in very poor in-river migration conditions in 2001. Up to 99% of Snake River yearling chinook and steelhead were transported from the Snake River collection projects. Approximately 96% of Snake River juvenile sub-yearling fall chinook were transported. Of Mid-Columbia origin yearling chinook, 35% were transported, of steelhead 30% were transported and of sub yearling chinook, 59% were transported. Based upon data collected on the run-at-large, the juvenile survival to Lower Granite Dam of wild and hatchery yearling chinook and wild and hatchery steelhead were the lowest observed in the last four years. In 2001, as the result of the lowest observed flows in recent years, travel times through the hydro system for spring chinook yearlings and steelhead was approximately twice as long as has been observed historically. Juvenile survival estimates through each index reach of the hydro system for steelhead and chinook juveniles was the lowest observed since the use of PIT tag technology began for estimating survival.

I. 2001 WATER SUPPLY

A. Water Supply Overview

Extremely poor water conditions within the Columbia River Basin along with an extraordinary power market created a unique water situation in Water Year 2001. Monthly 2001 precipitation at the Columbia River above Grand Coulee, the Snake River above Ice Harbor, and the Columbia River above The Dalles averaged approximately 70% of average. As a result, the 2001 January-July runoff at The Dalles was the second lowest in Columbia River recorded history. As a compounding factor to the near record low flows in 2001, California energy deregulation created a financial crisis for the BPA. In February of 2001, the BPA declared a “power emergency” and suspended many of the ESA and the Opinion measures. As a consequence, Opinion flow and spill measures for fish passage were not implemented.

B. Precipitation

Water Year 2001 was an exceptionally dry year. Monthly precipitation at the Columbia River above Grand Coulee, the Snake River above Ice Harbor, and the Columbia River above The Dalles ranged between 20% and 198% of average[1]. Precipitation among the three locations averaged approximately 72% of average over Water Year 2001 (Table 1). Overall, only the months of October, April, June, and July were above normal in terms of precipitation (Table 1, Figure 1). Because the 2001 Water Year began with relatively dry soils (low soil moisture content), early downstream runoff was compensated to some degree to recharge depleted soil moisture. The following paragraphs briefly evaluate monthly precipitation and related conditions over WY 2001.

Precipitation during October of 2001 was at or above average for the majority of the region (Table 1, Figure 1). October produced the highest average precipitation levels (96 to 198%) with respect to average in Water Year 2001. In addition, temperatures were at or above average across westside basins and below average across eastside basins.

The month of November was generally much drier than average (Table 1, Figure 1) and temperatures were typically below average. November precipitation averaged between 43 and

1. Average refers to average values calculated between the years of 1961 and 1990.

49% of average at the locations presented in Table 1 and Figure 1.

Precipitation for December was generally drier than average (53 to 59%) for most of the basin, while temperatures were predominantly below average (Table 1). With deficient precipitation and depleted soil moisture, December runoff was well below average. The majority of the region contained December runoff that was 50 to 70 percent of average. The January final water supply forecast (January-July) for the Columbia River at The Dalles was 80.4 million-acre feet (Maf)[1].

January precipitation was again well below average, while temperatures were predominantly above average. Minimal January precipitation restricted ordinary snow accumulations, February 1st snow water equivalents ranged from 35% to 65% of average in most areas. Snow pack deficiencies were the greatest in Canada, the Western Cascades, the Spokane drainage, and on the Clearwater River in Idaho. Observed runoff for January was extremely low ranging from 80-90% of average in the Upper Columbia River in Canada and the Upper Snake River to between 20-30% on the Yakima and Spokane Rivers. Overall, deficient precipitation and snow coupled with dry soil moisture conditions resulted in very limited water supply forecasts. The February final water supply forecast (January-July) for the Columbia River at The Dalles was 66.4 million-acre feet (Maf), 63% of average.

February precipitation and snow water equivalents were again below average. Observed runoff for February was also low; the Upper Columbia River in Canada and the Upper Snake River had February runoff in the 70-90% range, however most other drainages were between 40-60% of average. The March final water supply forecast (January-July) for the Columbia River at The Dalles was 58.6 million-acre feet (Maf).

March precipitation was nearly average across the northern Columbia Basin, however, the remainder of the region experienced drier than average conditions. Slight improvements in snow water equivalent percentages were seen in the northern portion of the basin, however, percentages dropped in Oregon and Central-Southern Idaho. Warmer temperatures combined with rainfall led to some increases in natural streamflow. The April final water supply forecast (January-July) for the Columbia River at The Dalles was 56.1 million-acre feet (Maf), or 53% of average.

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1. The January final water supply forecast utilized data collected primarily during December; therefore, it was deemed appropriate to include the January forecast in the brief analysis of December precipitation and runoff. This reasoning was also applied to months beyond December and January.

Precipitation for April 2001 was above average across the Owyhee, Salmon, Kootenai, Flathead, and Middle Columbia River Basins. In fact, precipitation was 120% of the 1961-1990 average at Columbia River above Coulee, 106% of average at the Snake River above Ice Harbor, and 117% of average at the Columbia River above The Dalles. Snow water equivalents increased in several basins in British Columbia, Montana, and Northern Idaho. Increased rainfall and snow-melt improved runoff in most areas of the Columbia Basin. The May final water supply forecast (January-July) at The Dalles was 56.5 Maf, or 53% of average.

In the month of May, below average rainfall and depleted snow packs produced slight decreases in runoff volumes in most Columbia Basins regions. Precipitation was 54% of average at the Columbia River above Coulee, 48% of average at the Snake River above Ice Harbor, and 64% at the Columbia River above The Dalles. Over the month of May, snow packs steadily melted and were mostly depleted by June 1st. The June final water supply forecast (January-July) at The Dalles was 55.5 Maf, decreasing slightly from May forecasts.

June precipitation was 117% of average at the Columbia above Coulee, 65% of average at the Snake River above Ice Harbor, and 99% of average at the Columbia above The Dalles. In June, very little snow pack remained with in the Columbia Basin. Additionally, streamflow was limited as most drainages produced only 25-45% of normal flow. The July final water supply forecast (January-July) at The Dalles was 54.7 Maf (52% of normal), just slightly above the record low of 53.4 Maf set in 1977.

July 2001 was cooler and wetter than the average of years 1961-1990. July precipitation was 102% of average at Columbia River above Coulee, 118% of average at the Snake River above Ice Harbor, and 103% of average at the Columbia River above The Dalles.

August 2001 was warmer and drier than average. Precipitation was 32% of average at the Columbia River above Coulee, 20% of average at the Snake River at Ice Harbor, and 32% at the Columbia River at The Dalles.

September of 2001 was also warmer and drier than the average of years 1961-1990. In September, precipitation was 48% of average at the Columbia River above Coulee, 54% of average at the Snake River at Ice Harbor, and 49% at the Columbia River at The Dalles.

TABLE 1. Average monthly precipitation over Water Year 2001 at the Columbia River above The Dalles, the Snake River above Ice Harbor, and the Columbia River above Coulee. Values are in percent of average precipitation recorded at the same location between 1961 and 1990.

Month	*Columbia River above The Dalles*	*Snake River above Ice Harbor*	*Columbia River above Grand Coulee*
	% of Average1961-1990	*% of Average1961-1990*	*% of Average1961-1990*
October	118	198	96
November	49	48	43
December	54	59	53
January	40	51	36
February	51	55	55
March	82	71	84
April	117	106	120
May	62	48	59
June	99	65	117
July	103	118	102
August	32	20	32
September	49	54	48

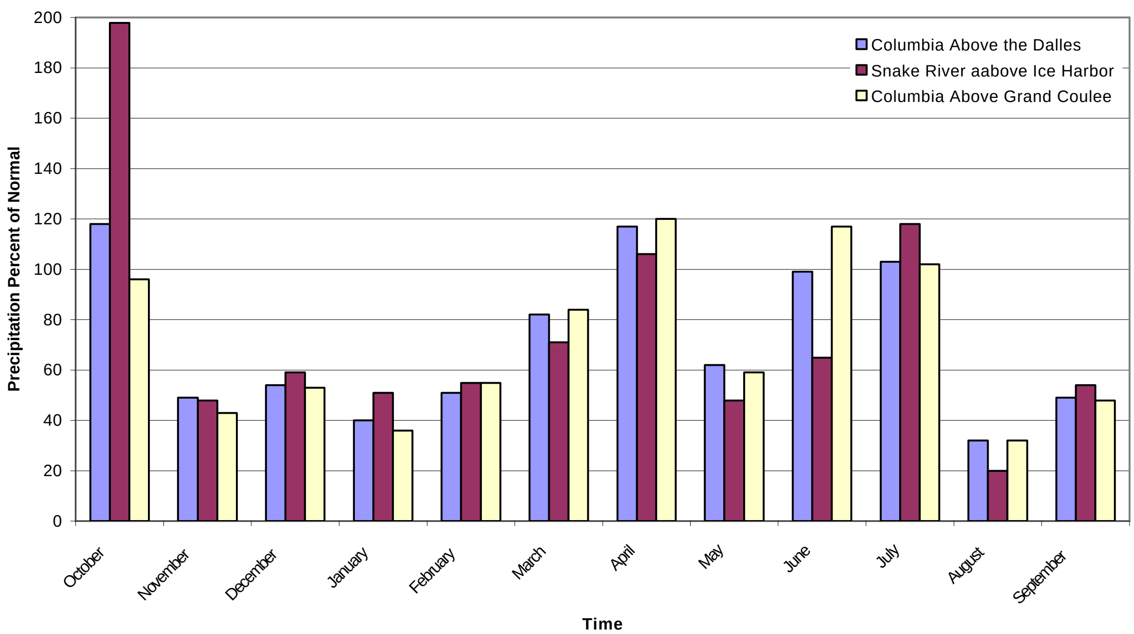

FIGURE 1. Water Year 2001 precipitation in percentage of the 1961 to 1990 average.

C. Reservoir Operations

In general, precipitation was extremely low in WY 2001. As a result, runoff volumes in many basins were well below average. Table 2 displays the January, February, March, and April final runoff volume forecasts for various reservoirs within the Columbia and Snake Basins. From Table 2, not one of the reservoirs contained an average (i.e., 100% of average) runoff volume forecast over the presented months. The highest and lowest April forecasts were at the Mica and Weiser (ID) reservoirs, 77% and 32% of average, respectively.

Table 3 compares the 2001 actual January-July runoff volume with the January-July runoff volume recorded between the years 1992 and 2000 at the Columbia River above Grand Coulee, the Columbia River above The Dalles, and the Snake River above Lower Granite. From Table 3, 2001 produced very minimal runoff volumes at each of the three locations in comparison to previous years. As a result of very limited water yields, reservoir operations were largely influenced.

TABLE 2. January, February, March, and April 2001 Final Runoff Volume Forecasts for various reservoirs within the Columbia and Snake River Basins

Site	January Final		February Final		March Final		April Final	
	Runoff Volume (Kaf)	% of Ave	Runoff Volume (Kaf)	% of Ave	Runoff Volume (Kaf)	% of Ave	Runoff Volume (Kaf)	% of Ave
Mica (April-Sept)	10800	85	9990	78	9620	76	9800	77
Hungry Horse (April-Sept)	1550	71	1320	60	1320	60	1300	60
Libby (April-Sept)	5110	75	4180	62	3570	53	3530	52
Grand Coulee (Jan-July)	48880	77	41200	65	37600	59	37500	59
The Dalles (Jan-July)	80400	76	66400	63	58600	55	56100	53
Brownlee (April-July)	3530	61	2850	49	2390	41	1890	33
Dworshak (April-July)	2300	85	1800	67	1550	57	1400	52
Lower Granite (Jan-July)	23600	79	18800	63	16300	55	14100	47
Heise (ID) (April-July)	3010	87	2230	65	2170	63	2030	59
Weiser (ID) (April-July)	3230	59	2620	48	2230	41	1730	32

TABLE 3. January through July actual runoff volumes for the 1992-2001 period at the Columbia River above Grand Coulee, the Columbia River above The Dalles and the Snake River above Lower Granite.

Year	Columbia above Grand Coulee		Columbia above The Dalles		Snake River above Lower Granite	
	Runoff Volume (Maf)	% of Ave	Runoff Volume(Maf)	% of Ave	Runoff Volume(Maf)	% of Ave
1992	46.5	74	70.4	66	14.1	47
1993	49.1	78	88.0	83	26.7	90
1994	50.9	80	75.0	71	15.9	53
1995	59.0	93	104.0	98	29.4	99
1996	78.9	135	139.3	132	42.4	143
1997	88.2	137	159.0	150	49.5	166
1998	59.0	93	104.5	98	31.3	105
1999	71.3	115	124.1	117	36.1	121
2000	61.1	96	98.0	92	24.7	83
2001	37.4	59	58.2	55	14.4	48

Hydrosystem operations for fish passage are based upon the National Marine Fisheries Services' (NMFS) 1995 and 2000 Federal Columbia River Power System Opinion. The Opinion contains provisions for flow targets, refill and draft specifications for reservoirs, spill levels, and transportation specifications. The Opinion also specifies that all reservoirs should be operated to accomplish their April flood control target elevation to maximize storage available for flow augmentation, and that reservoirs should refill by June 30th to maximize storage for summer augmentation. The intent of the Opinion is to conserve water for summer flow augmentation while not substantially reducing spring flows.

On February 12th of 2001, the BPA declared a "power emergency" that lasted through February 20th. On April 3rd, 2001 the BPA again declared a power emergency that was in effect for the remainder of the Opinion period. As a consequence, many of the Endangered Species Act and the Opinion measures were suspended. Limited flows were provided for migrating salmon, and spill was either eliminated or minimal in much of the Snake and Lower Columbia Rivers.

1. Storage Reservoirs

During Water Year 2001 storage reservoirs were primarily operated for power generation. Generally, reservoirs were drafted well below their flood control targets to meet power needs in the fall/winter. Table 4 displays the end of March and April Flood Control targets and the actual reservoir elevations for several storage reservoirs. Table 5 displays the full pool elevations, the June 30th elevations, and the date of highest reservoir elevation for the Libby, Hungry Horse, Grand Coulee, Brownlee, and Dworshak reservoirs. Table 6 demonstrates the estimated 2001 April 10th Opinion flood control elevations at Libby, Hungry Horse, Grand Coulee, Brownlee, and Dworshak reservoirs. Table 7 demonstrates the minimum, maximum, and average inflows, outflows, and elevations for selected reservoirs over WY 2001.

TABLE 4. End of March and April 2001 flood control targets and actual reservoir elevations at Brownlee, Libby, Grand Coulee, Dworshak, and Hungry Horse. Elevation recordings are in feet above mean sea level (AMSL).

Site	March 31 Flood Con. Target (AMSL)	March 31 Actual Res. Elev. (AMSL)	April 30 Flood Con. Target (AMSL)	April 30 Actual Res. Elev. (AMSL)	Full Pool Elev. (AMSL)
Libby	2448.0	2387.6	2448.0	2387.0	2459.0
Hungry Horse	3555.2	3491.6	3558.2	3491.8	3560.0
Grand Coulee	1283.3	1222.7	1283.3	1221.0	1290.0
Brownlee	2077.0	2073.7	2077.0	2075.7	2077.0
Dworshak	1581.8	1512.3	1597.4	1531.5	1600.0

TABLE 5. Full pool elevations, elevations on June 30, 2001, and the date of highest reservoir elevation for the Libby, Hungry Horse, Grand Coulee, Brownlee, and Dworshak reservoirs.

Project	Full PoolElev. (ft AMSL)	Reservoir Elev. June 30 2002 (ft AMSL)	Date of Max. 2001 Res. Elev.
Libby	2459	2431.1	August 2
Hungry Horse	3560	3541.4	July 20
Grand Coulee	1290	1280.9	July 11
Brownlee	2077	2075.5	May 16
Dworshak	1600	1587.4	July 1

TABLE 6. Estimated Opinion April 10th targets and actual elevations at Libby, Hungry Horse, Grand Coulee, Brownlee, and Dworshak.

Project	Estimated April 10 Biological OpinionElevations* (ft AMSL)	Actual April 10 Reservoir Elevation(ft AMSL)
Libby	na	2386.7
Hungry Horse	3555.9	3489.7
Grand Coulee	1283.3	1220.2
Brownlee	2077.0	2074.4
Dworshak	1586.9	1516.7

*April 10th Opinion elevations were calculated by interpolating between the March 31st and April 15th flood control elevations.

TABLE 7. 2001 monthly inflows, outflows, and reservoir elevations at Brownlee, Libby, Grand Coulee, Dworshak, and Hundry Horse.

			March	April	May	June	July
Brownlee							
	***Inflow** (kcfs)*						
		Min	*6.6*	*5.1*	*6.7*	*4.5*	*4.4*
		Max	*18.5*	*14.7*	*19.7*	*13.6*	*15.6*
		Ave	*12.4*	*11.5*	*11.7*	*8.3*	*9.3*
	***Outflow** (kcfs)*						
		Min	*8.8*	*7.4*	*8.5*	*7.0*	*7.0*
		Max	*18.6*	*15.9*	*19.7*	*13.2*	*15.7*
		Ave	*12.9*	*12.2*	*12.5*	*8.5*	*9.4*
	Elevation (AMSL)						
		Min	*2069.2*	*2073.6*	*2075.7*	*2075.5*	*2067.7*
		Max	*2076.0*	*2075.7*	*2077.0*	*2076.6*	*2075.6*
		Ave	*2073.2*	*2074.6*	*2076.3*	*2076.1*	*2072.7*
Libby							
	***Inflow** (kcfs)*						
		Min	*1.7*	*1.8*	*5.3*	*13.4*	*6.0*
		Max	*3.3*	*12.9*	*38.3*	*25.0*	*15.7*
		Ave	*2.7*	*3.8*	*16.5*	*17.3*	*9.9*
	***Outflow** (kcfs)*						
		Min	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*
		Max	*6.0*	*4.5*	*4.0*	*4.0*	*8.9*
		Ave	*4.4*	*4.1*	*4.0*	*4.0*	*6.2*
	Elevation (AMSL)						
		Min	*2387.6*	*2385.5*	*2387.4*	*2411.4*	*2431.6*
		Max	*2390.9*	*2387.5*	*2410.6*	*2431.1*	*2436.6*
		Ave	*2389.0*	*2386.3*	*2395.3*	*2422.2*	*2435.0*
G. Coulee							
	***Inflow** (kcfs)*						
		Min	*53.9*	*52.7*	*82.5*	*77.2*	*40.4*
		Max	*82.5*	*95.4*	*133.7*	*120.0*	*84.6*
		Ave	*70.4*	*63.8*	*106.2*	*95.6*	*58.0*
	***Outflow** (kcfs)*						
		Min	*41.2*	*34.1*	*20.9*	*42.7*	*29.8*
		Max	*110.8*	*85.8*	*74.9*	*105.4*	*81.5*
		Ave	*72.8*	*60.5*	*47.9*	*78.4*	*50.6*
	Elevation (AMSL)						
		Min	*1221.1*	*1216.7*	*1222.6*	*1273.9*	*1280.7*
		Max	*1226.3*	*1223.3*	*1272.6*	*1282.4*	*1284.6*
		Ave	*1223.3*	*1219.4*	*1246.1*	*1279.8*	*1282.3*

TABLE 7. 2001 monthly inflows, outflows, and reservoir elevations at Brownlee, Libby, Grand Coulee, Dworshak, and Hundry Horse.
(con't)

Dworshak							
	Inflow (kcfs)						
		Min	*1.0*	*2.9*	*8.2*	*2.9*	*0.3*
		Max	*6.7*	*14.3*	*18.6*	*9.6*	*2.9*
		Ave	*3.5*	*5.8*	*11.7*	*5.4*	*1.4*
	Outflow (kcfs)						
		Min	*1.4*	*1.4*	*1.4*	*1.6*	*1.8*
		Max	*1.5*	*1.8*	*1.7*	*1.8*	*10.0*
		Ave	*1.5*	*1.5*	*1.5*	*1.7*	*8.8*
	Elevation (AMSL)						
		Min	*1501.9*	*1513.0*	*1533.9*	*1575.0*	*1559.0*
		Max	*1512.3*	*1531.5*	*1574.2*	*1587.4*	*1587.5*
		Ave	*1505.5*	*1519.6*	*1554.4*	*1582.7*	*1575.1*
H. Horse							
	Inflow (kcfs)						
		Min	*-1.2*	*-0.5*	*4.1*	*2.4*	*0.0*
		Max	*1.7*	*9.1*	*19.4*	*19.1*	*3.6*
		Ave	*0.5*	*1.9*	*10.4*	*6.4*	*1.5*
	Outflow (kcfs)						
		Min	*2.4*	*0.5*	*0.5*	*0.5*	*0.5*
		Max	*2.8*	*2.4*	*0.5*	*0.9*	*1.6*
		Ave	*2.5*	*2.0*	*0.5*	*0.5*	*1.0*
	Elevation (AMSL)						
		Min	*3491.6*	*3487.6*	*3492.6*	*3526.0*	*3541.7*
		Max	*3498.7*	*3491.8*	*3525.1*	*3541.4*	*3543.2*
		Ave	*3494.9*	*3489.2*	*3506.8*	*3534.9*	*3542.8*

Brownlee

Over the spring 2001, Brownlee was operated to meet power generation needs and to meet flood control targets (Figure 2). During March, Brownlee inflows were roughly equivalent to outflows. In particular, inflows at Brownlee ranged between 6.6 and 18.5 Kcfs and averaged 12.4 Kcfs in March of 2001 (Table 7). On the other hand, outflows ranged between 8.8 and 18.6 Kcfs and average 12.9 Kcfs over the same period (Table 7). Over March 2001, the Brownlee Reservoir filled slightly; beginning the month at 2069.3 feet and ending the month at 2073.7 feet Above Mean Sea Level (AMSL). The end of March flood control target elevation issued by the COE (using the March final water supply forecast) was 2077.0 feet AMSL; this was also the full pool elevation (Table 4). Therefore, by the end of March, the Brownlee Reservoir was 3.3 feet below the desired flood control elevation and full pool.

The estimated April 10th Opinion target elevation for the Brownlee Reservoir was 2077.0 feet AMSL; the actual reservoir elevation on April 10th was 2074.4 feet AMSL (Table 6). Flood control targets issued by COE for the end of April were again at the full pool elevation of 2077.0 feet AMSL. By the end of April, Brownlee Reservoir was only 1.3 feet below the April flood control elevation (Table 4). Throughout the entire month of April, the Brownlee Reservoir was operated within 3.5 feet of the flood control target and full pool elevation. Moreover, the Brownlee reservoir essentially passed inflows during the month of April (Table 7).

During the month of May, reservoir operations at Brownlee were very similar to those in April (Figure 2, Table 4 and Table 7). Essentially, Brownlee passed inflow and reservoir elevations were no more than 1.3 feet from the full pool elevation (2077.0 feet AMSL). On May 16, 2001 the Brownlee Reservoir reached a maximum elevation of 2077.0 feet AMSL (Table 5).

Reservoir operations in June of 2001 were similar to those in May (Figure 2). Brownlee passed inflow and reservoir elevations remained approximately steady (began and ended June at 2075.9 and 2075.5 feet AMSL, respectively). The Brownlee Reservoir was very close (i.e., 1.5 feet) to its full pool elevation by June 30th of 2001, as suggested in the Opinion (Table 6).

Brownlee began to continuously draft reservoir water during the month of July 2001. In particular, the reservoir began the month of July at an elevation of 2075.6 feet and ended the month at 2067.7 feet AMSL, a total draft over the month of 7.9 feet (Figure 2, Table 7). Drafting continued through the months of August and September of 2001. The Brownlee Reservoir ended water year 2001 at 2050.4 feet AMSL.

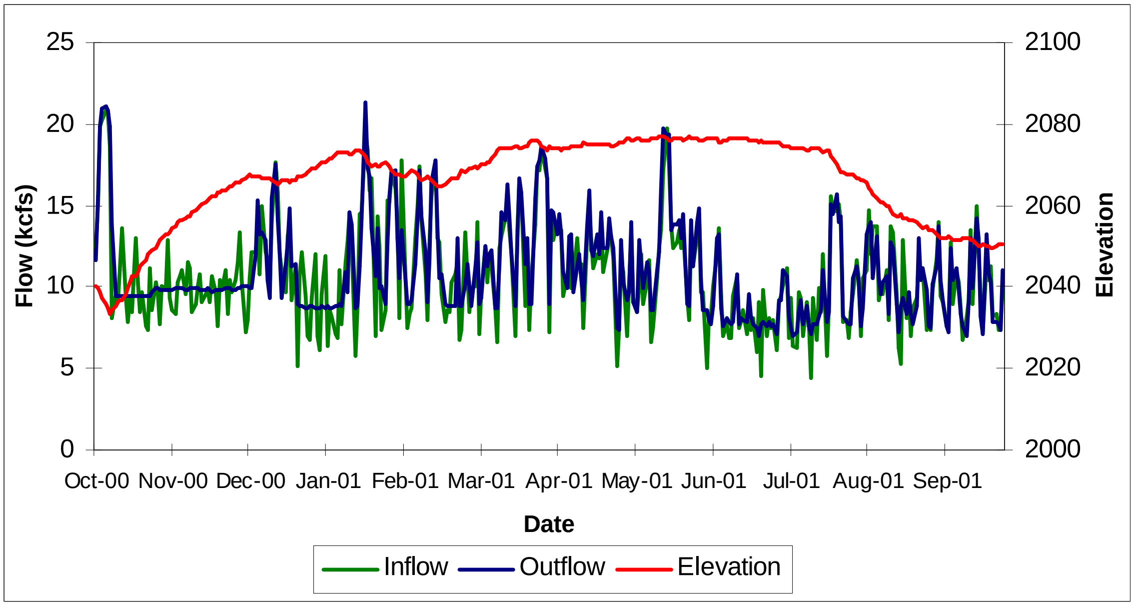

FIGURE 2. Inflows, outflows, and reservoir elevations at the Brownlee Reservoir over Water Year 2001.

Dworshak

During WY 2001, Dworshak was primarily operated for power generation. Throughout the spring of 2001, Dworshak was drafted well below COE flood control targets. The end of March flood control target was 1581.8 feet; where as, the actual reservoir elevation at the end of March was 1512.3 feet AMSL, a difference of 69.5 feet (Table 4). The estimated April 10th Opinion target elevation for the Dworshak Reservoir was 1586.9 feet AMSL; the actual reservoir elevation on April 10th was 1516.7 feet AMSL (Table 6). Additionally, the end of April flood control target was 1597.4 feet, while the actual end of April reservoir elevation was 1531.5 feet AMSL, a difference of 65.9 feet (Table 4).

Dworshak began Water Year 2001 at 1519.7 feet and ended at 1516.7 feet AMSL. Storage at the Dworshak Reservoir remained approximately constant through the beginning of WY 2001. From October through January 21st of 2001, the reservoir changed only 3.3 feet in elevation, from 1519.7 feet on October 1st to 1516.4 feet AMSL on January 21st of 2001. From January 22nd to March 4th, 2001, Dworshak was drafted to 1501.9 feet AMSL. Beyond March 4th, Dworshak was refilled to a maximum elevation of 1587.5 feet AMSL on July 1st, 2001 (Table 5). After July 1st of 2001, the Dworshak Reservoir was drafted to an elevation of 1516.7 feet AMSL at the end of the 2001 Water Year (Figure 3).

Through March, April, May and much of June, Dworshak (Table 7) was operated at a minimum outflow of 1.5 Kcfs. During July and August, outflows increased up to and above 10 Kcfs (Figure 3). Increased outflow from Dworshak during the mid to late summer months is often used to mitigate increased temperatures at the Lower Granite Reservoir.

According to the Opinion, Dworshak should attempt to refill by the 30th of June each year. During 2001, Dworshak did not refill; the full pool elevation at Dworshak is 1600 feet and the maximum actual elevation achieved was 1587.5 feet AMSL on July 1st, 2001 (Table 5).

The Opinion also calls for draft to be limited to 1520 feet AMSL by August 31st to benefit summer juvenile fish migration. On August 31st, 2001, the Dworshak Reservoir was at an elevation of 1520.5 feet AMSL, just 0.5 feet above the maximum draft limit.

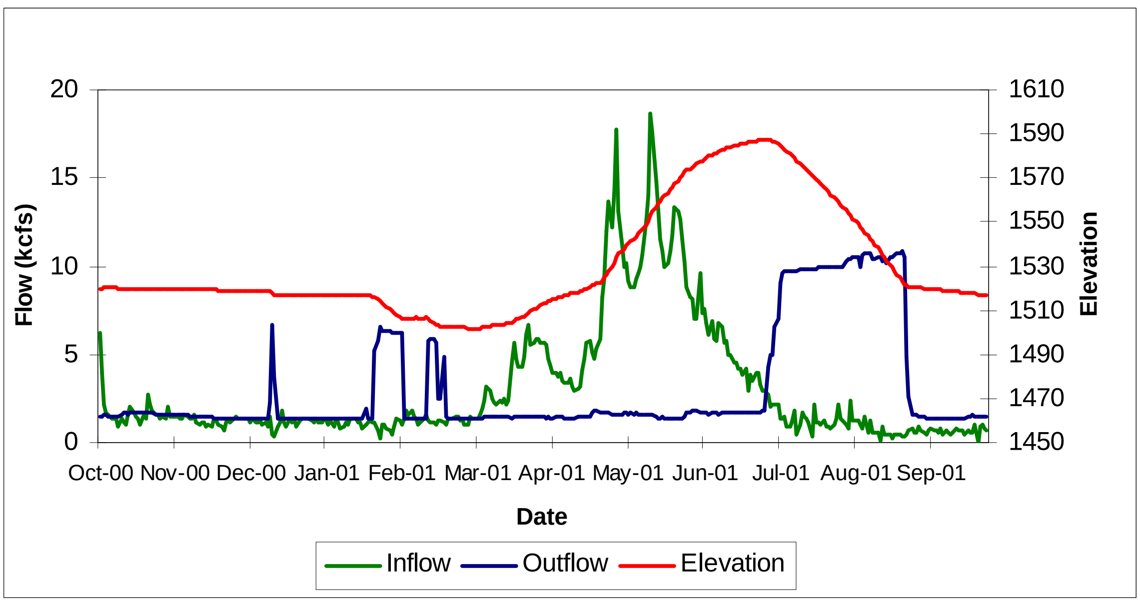

FIGURE 3. Inflows, outflows, and reservoir elevations at Dworshak over Water Year 2001.

Libby

During the winter months, Libby was primarily operated to meet power generation needs. Overall, Libby drafted water throughout the first portion of Water Year 2001; beginning the water year on October 1, 2000 at 2432.2 feet AMSL and ending the draft period on April 25th at 2385.5 feet AMSL. Beyond April 25th 2001, Libby was refilled reaching a maximum of 2436.6 feet AMSL on August 2nd, 2001 (Table 5). Figure 4 displays the operation of the Libby Reservoir over WY 2001.

Throughout spring and summer of 2001, the Libby Reservoir demonstrated a strong draft/ refill regime. In March, outflows averaged 4.4 Kcfs and inflows 2.7 Kcfs, resulting in a 3.3 feet of reservoir draft. The end of March flood control target for Libby was 2448.0 feet AMSL; the actual elevation of the reservoir was 2387.6 feet (Table 4), a difference of 60.4 feet. In April, outflows were slightly larger than inflows; outflows averaged 4.1 Kcfs and inflows averaged 3.8 Kcfs (Table 4). As a result, the Libby Reservoir dropped one-half a foot in elevation over the month of April. The end of April flood control target was 2448.0 feet AMSL; the actual elevation at the end of April was 2387.0 feet, a 61.0-foot difference (Table 4).

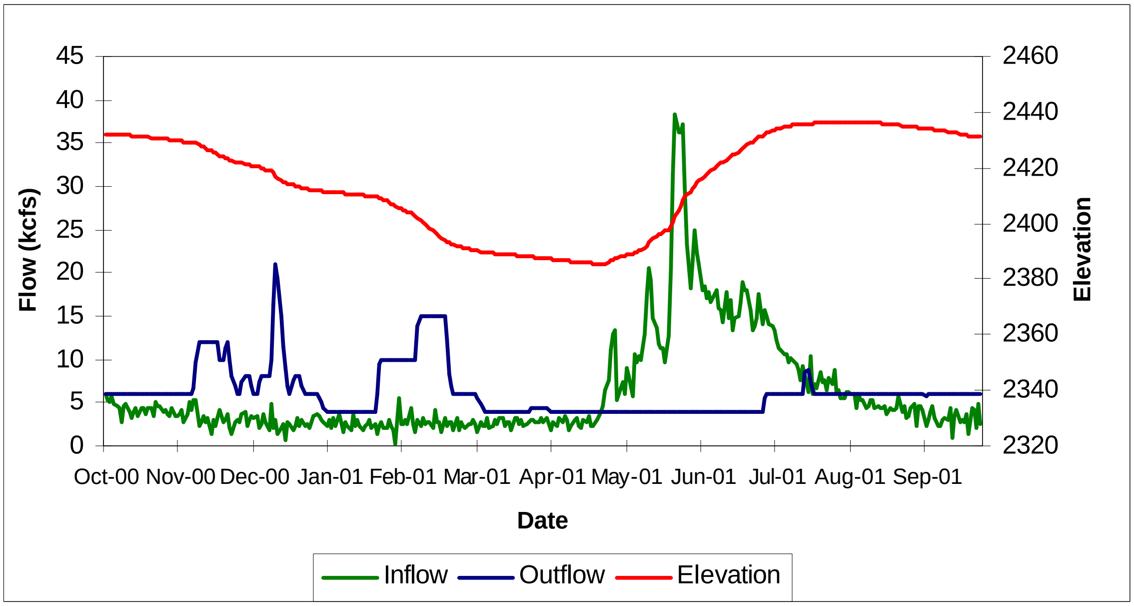

FIGURE 4. Inflows, outflows, and reservoir elevations at the Libby Reservoir over Water Year 2001.

In May of 2001, the Libby Reservoir began to refill, as a result of increases in spring run-off. May outflows averaged 4.0 Kcfs (the minimum) and inflows averaged 16.5 Kcfs, resulting in 23.2 feet of reservoir refill. Similarly, outflows in June of 2001 averaged 4.0 Kcfs and inflows averaged 17.3 Kcfs, resulting in 19.7 feet of refill. Lastly, July inflows at Libby averaged 9.9 Kcfs, where as, July outflows averaged 6.2 Kcfs, resulting in 5 feet of refill (Table 7). The Libby Reservoir reached a maximum level of 2436.6 feet AMSL on August 2nd, 2001. The full pool elevation for Libby is 2459.0 feet AMSL (Table 5). Therefore, during WY 2001, the Libby Reservoir did not reach its full pool elevation by June 30th, as recommended in the Opinion (Opinion). Furthermore, the Opinion recommends limiting draft by August 31st to 2439 feet above MSL at Libby. The actual elevation of Libby was 2434.9 on August 31st, 2001; 4.1 feet below the Opinion recommendation.

Grand Coulee

In WY 2001, Grand Coulee was primarily operated to meet power generation needs. Grand Coulee began the 2001 water year on October 1, 2000 at 1285.6 feet AMSL. Beginning in November of 2000, Grand Coulee began to draft and continued drafting through the winter and spring months, reaching a minimum elevation of 1216.7 feet AMSL on April 20th, 2001. From April 21st to June 18th, Grand Coulee refilled to an elevation of 1282.4 feet AMSL. Beyond June 18th, 2001, reservoir elevations at Grand Coulee remained constant. Figure 5 displays the operation of the Grand Coulee Reservoir over WY 2001.

Throughout March, inflows averaged 70.4 Kcfs while outflows averaged 72.8 Kcfs resulting in a draft of 3.6 feet of water. The end of March flood control elevation determined by the COE was 1283.3 feet AMSL (Table 7). The actual end of March reservoir elevation was 1222.7 feet AMSL, 60.6 feet below the flood control target.

The estimated April 10th Opinion target elevation for the Grand Coulee Reservoir was 1283.3 feet AMSL; the actual reservoir elevation on April 10th was 1220.2 feet AMSL, a difference of 63.1 feet (Table 6). In April of 2001, inflows averaged 63.8 Kcfs while outflows averaged 60.5 Kcfs. The April flood control target determined by the COE was 1283.3 feet AMSL (Table 4). The actual end of April reservoir elevation was 1221.0 feet AMSL, 62.3 feet below the flood control target.

In May, outflows (47.9 Kcfs) were much smaller than inflows (106.2 Kcfs), resulting in 50 feet of reservoir refill at Grand Coulee.

The Grand Coulee Reservoir did not refill during 2001. The full pool elevation at Grand Coulee is 1290.0 feet AMSL; the maximum elevation achieved at Grand Coulee during 2001 was 1284.6 feet AMSL on July 11th, 2001 (Table 5). Based on the July final April-August runoff volume forecast, the Opinion called for draft at Grand Coulee to be limited to 1278 feet AMSL by the end of August to benefit summer juvenile fish migration. At the end of August in 2001, the Grand Coulee Reservoir was at 1278.3 feet above MSL, 0.3 feet above the Opinion draft limit.

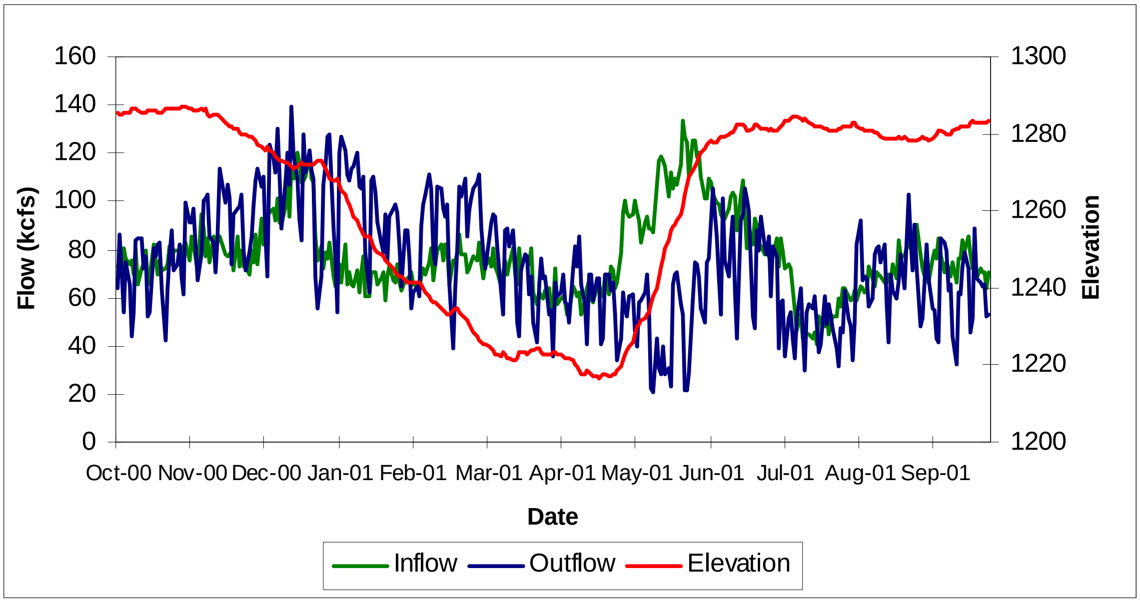

FIGURE 5. Inflows, outflows, and reservoir elevations at the Grand Coulee Reservoir over Water Year 2001.

Hungry Horse

During WY 2001, the Hungry Horse Reservoir was primarily operated to meet power generation needs and the Columbia Falls minimum flow requirements. Over the first half of WY 2001, Hungry Horse drafted water; beginning the water year on October 1, 2000 at 3535.9 feet AMSL and ending the draft period on April 24th at 3487.6 feet AMSL. Beyond April 24th 2001, Hungry Horse was refilled reaching a maximum of 3543.2 feet AMSL on July 20th, 2001. Figure 6 displays the operation of the Hungry Horse Reservoir over WY 2001.

Throughout the spring and summer of 2001, the Hungry Horse Reservoir was drafted and refilled. In March, outflows averaged 2.5 Kcfs and inflows 0.5 Kcfs, resulting in 7.1 feet of reservoir draft. The end of March flood control target for Hungry Horse was 3555.2 feet AMSL; the actual elevation of the reservoir was 3491.6 feet (Table 4), a difference of 63.6 feet. The estimated April 10th Opinion target elevation for the Hungry Horse Reservoir was 3555.9 feet AMSL; the actual reservoir elevation on April 10th was 3489.7 feet AMSL, a difference of 66.2 feet (Table 6). In April, outflows were slightly larger than inflows; outflows averaged 2.0 Kcfs and inflows averaged 1.9 Kcfs (Table 7). The end of April flood control target was 3558.2 feet AMSL; the actual elevation at the end of April was 3491.8 feet, a difference of 66.4 feet.

In May of 2001, the Hungry Horse Reservoir began to refill, as a result of increases in spring runoff. May outflows averaged 0.5 Kcfs (the minimum) and inflows averaged 10.4 Kcfs, resulting in 32.5 feet of reservoir refill. Similarly, outflows in June of 2001 averaged 0.5 Kcfs and inflows averaged 6.4 Kcfs, resulting in 15.4 feet of refill. Lastly, July inflows at Hungry Horse averaged 1.5 Kcfs, where as, July outflows averaged 1.0 Kcfs, resulting in 1.4 feet of refill (Table 7). The Hungry Horse Reservoir reached a maximum level of 3543.2 feet AMSL on July 20th, 2001 (Table 5). The full pool elevation for Hungry Horse is 3560.0 feet AMSL (Table 5). Therefore, during WY 2001, the Hungry Horse Reservoir did not reach its full pool elevation by June 30th, as recommended in the Opinion. Furthermore, the Opinion recommends limiting draft by August 31st to 3540 feet AMSL at Hungry Horse. The actual elevation of Hungry Horse was 3539.4 feet AMSL on August 31st, 2001; 0.6 feet below the Opinion recommendation.

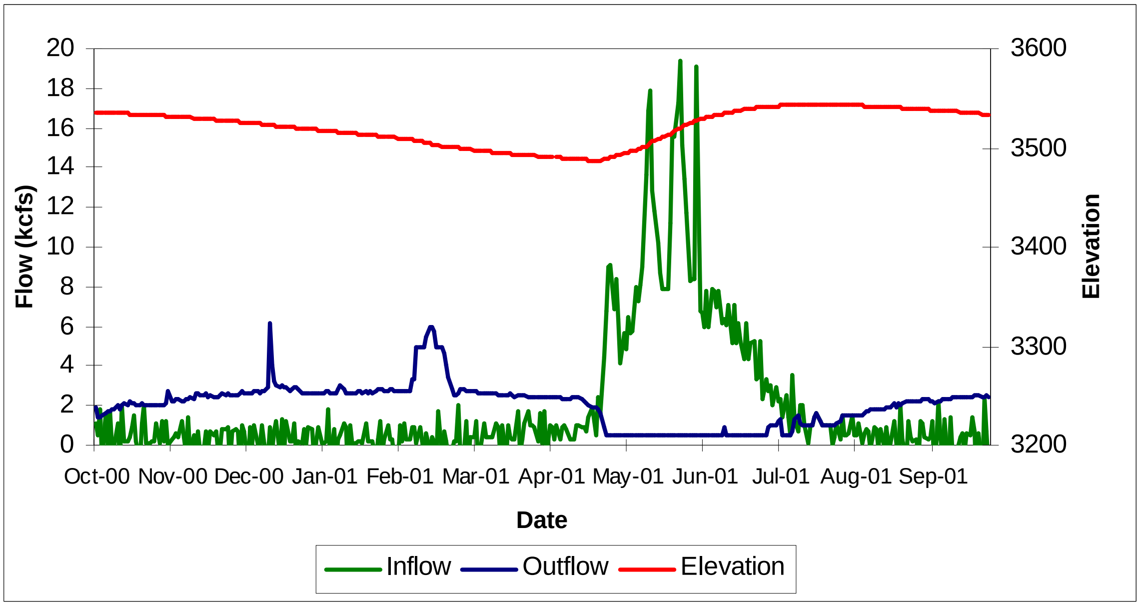

FIGURE 6. Inflows, outflows, and reservoir elevations at the Hungry Horse Reservoir over Water Year 2001

2. Run-of-the-River Projects

The BPA declared a financial emergency which prioritized hydrosystem operations for power generating. Therefore, flows at the run-of-the-river projects were well below the Opinion flow requirements.

Lower Granite

According to the Opinion, the spring flow objective at Lower Granite ranges between 85-100 Kcfs, depending on the April final water supply forecast (April-July) at Lower Granite. In 2001, the April final water supply forecast (April-July) was 14100 Kaf, or 14.1 Maf. According to the Opinion, if the April final water supply forecast (April-July) were less than 16 Maf the flow objective would be 85 Kcfs at Lower Granite between April 3rd and June 20th. Figure 7 displays the Opinion flow objective and the actual flows between April 3rd and June 20th, 2001 at Lower Granite.

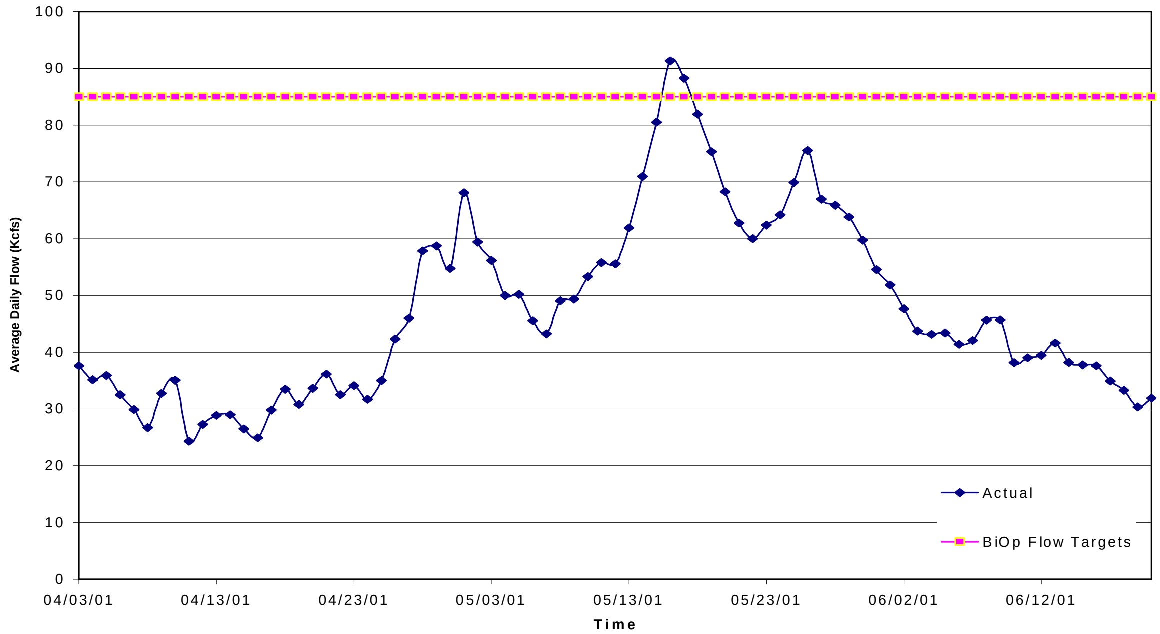

FIGURE 7. The Opinion spring flow objective and the actual flows between April 3rd and June 20th, 2001 at Lower Granite.

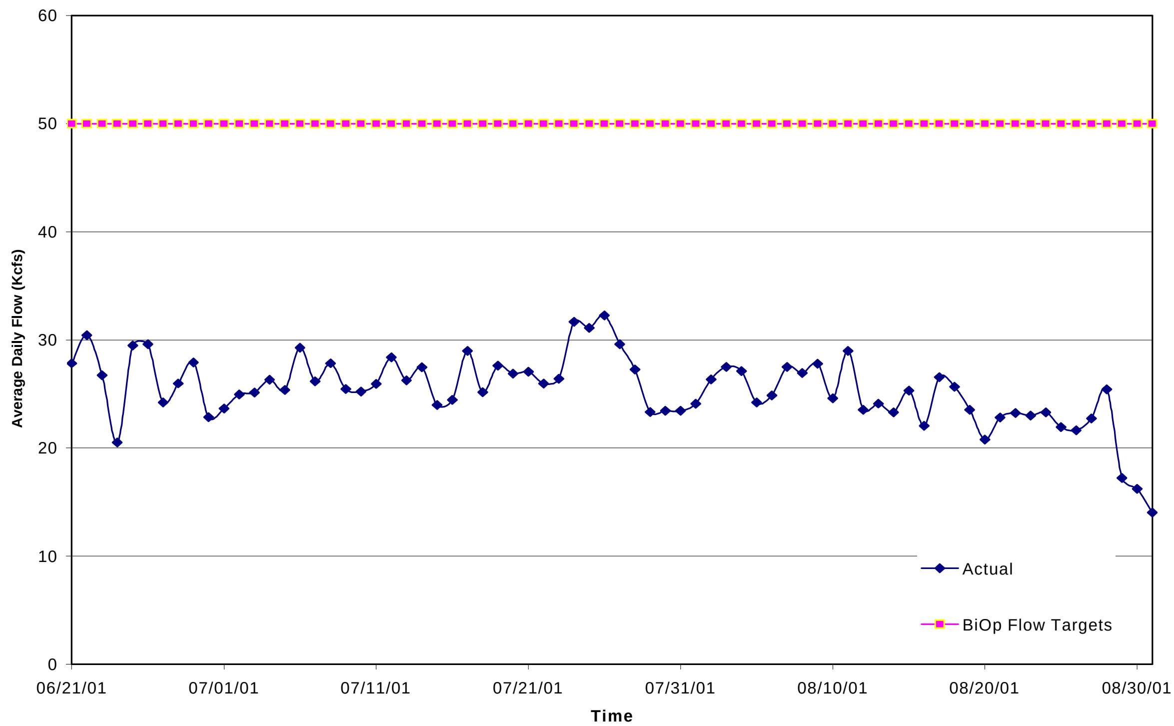

FIGURE 8. The 2001 Opinion summer flow objective and the actual flows between June 21st and August 31st at Lower Granite.

The average flows at Lower Granite from April 3rd to June 20th, 2001 were 47.5 Kcfs, well below the Opinion target of 85 Kcfs. Furthermore, from Figure 7, only two of the 78 days representing the period from April 3rd to June 20th contained flows of 85 Kcfs or more.

The summer flow objective at the Lower Granite Reservoir ranges between 50-55 Kcfs, depending on the June final water supply forecast at Lower Granite. In 2001, the June final water supply forecast was 14800 Kaf, or 14.8 Maf. According to the Opinion, if the June final water supply forecast were less than 16 Maf the flow objective would be 50 Kcfs at Lower Granite between June 21st and August 31st. Figure 8 displays the Opinion flow objective and the actual flows between June 21st and August 31st, 2001 at Lower Granite.

The average flows at Lower Granite from June 21st to August 31st, 2001 were 25.4 Kcfs, well below the Opinion target of 50 Kcfs. Furthermore, from Figure 8, zero of the 72 days representing the period from June 21st to August 31st contained flows of 50 Kcfs or more.

Priest Rapids

According to the Opinion, the spring flow objective at Priest Rapids is 135 Kcfs from April 10th to June 30th. Figure 9 displays the Opinion target flow (135 Kcfs) along with the actual recorded flows at Priest Rapids from April 10th to June 30th. The average flow at Priest Rapids between April 10th and June 30th was 76.7 Kcfs. From Figure 9, zero of the 82 days representing the period from April 10th to June 30th contained flows of 135 Kcfs or more.

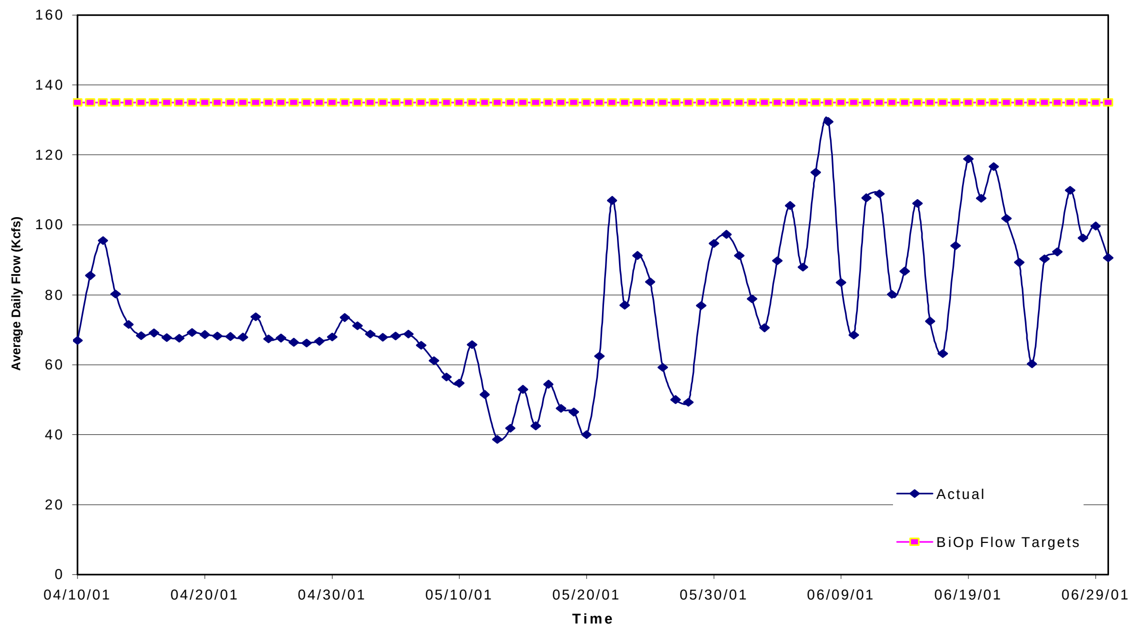

FIGURE 9. The Opinion spring flow objective and the actual flows between April 10th and June 30th, 2001 at Priest Rapids.

McNary

According to the Opinion, the spring flow objective at McNary ranges between 220 and 260 Kcfs from April 10th to June 30th. The actual Opinion flow is to be determined by the final April water supply forecast at The Dalles (April-August). Because the April final forecast at The Dalles (April-August) was less than 80 Maf, the flow objective at McNary was 220 Kcfs. Figure 10, displays the Opinion target flow (220 Kcfs) along with the actual recorded flows at McNary from April 10th and June 30th. The average flow at McNary between April 10th and June 30th was 123.9 Kcfs. From Figure 10, zero of the 82 days representing the period from April 10th to June 30th contained flows of 220 Kcfs or more.

The summer flow objective at McNary is 200 Kcfs between July 1st and August 31st. In 2001, the average flow at McNary was 90.9 Kcfs between July 1st and August 31st. Figure 11 displays the Opinion flow objective and the actual flows between July 1st and August 31st, 2001 at McNary.

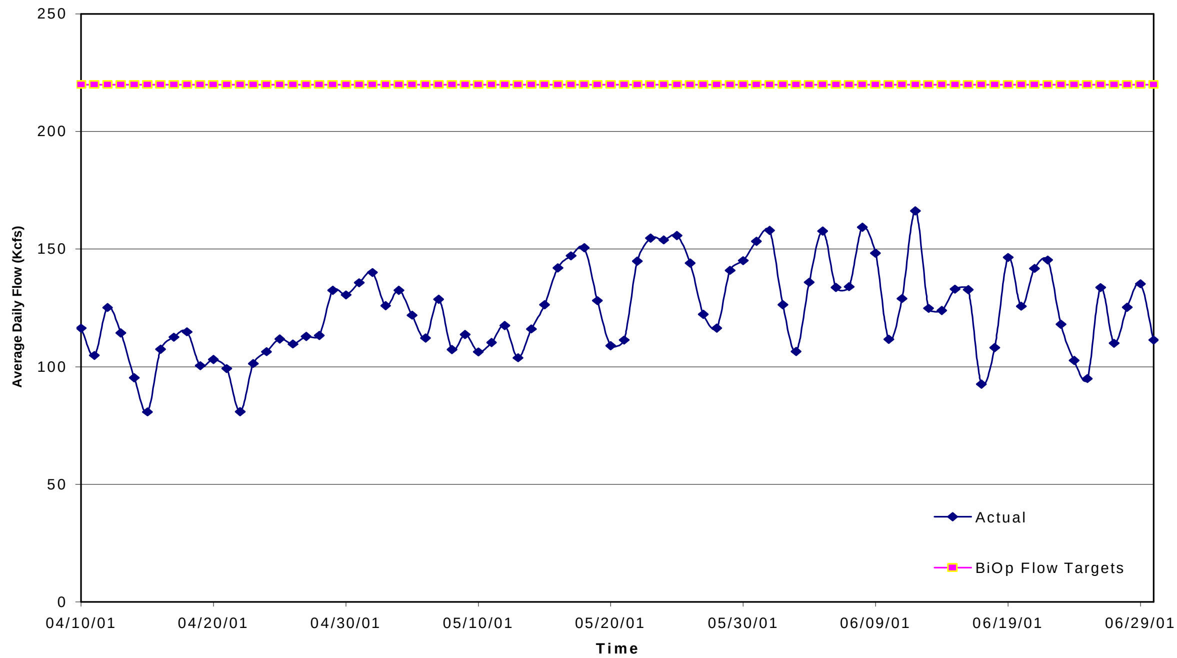

FIGURE 10. The Opinion spring flow objective and the actual flows between April 10th and June 30th, 2001 at McNary.

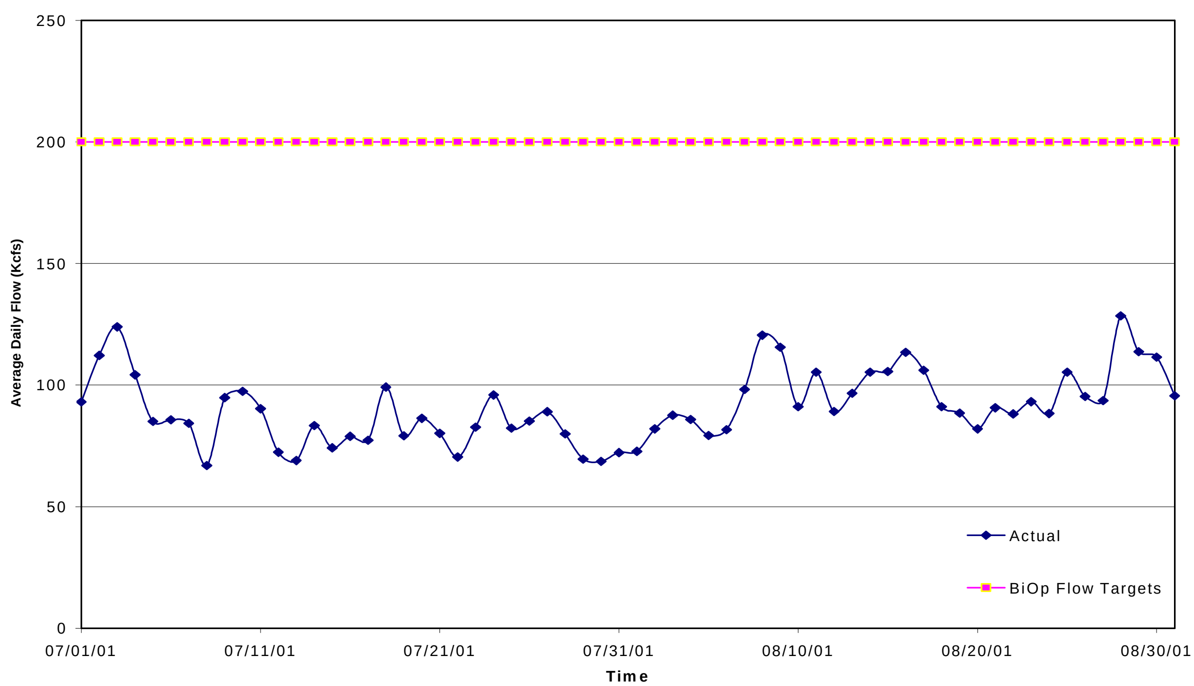

FIGURE 11. The Opinion summer flow objective and the actual flows between July 1st and August 31st, 2001 at McNary.

Bonneville

The NMFS Opinion requires specific flows below Bonneville Dam to protect the spawning incubation and emergence of listed chum salmon. Based upon early hydrologic data, the Opinion called for average flows of 125 Kcfs at Bonneville at the start of spawning, approximately November 1 through December 31, 2000. From December 31 to the end of emergence (approximately April 10, 2001), the Opinion suggested that flows average 125 Kcfs, but did not exceed 150 Kcfs. Flows at Bonneville averaged 138.6 Kcfs from November 1st to December 31st, 2001 and did not fall below the 125 Kcfs minimum (Figure 12). From January 1st to April 10th, flows at Bonneville averaged 129.1 Kcfs; however, fell below 125 Kcfs for a portion of this period. Also, flows at Bonneville averaged above 150 Kcfs for two of the days between January 1st and April 10th. Figure 12 displays daily flows at Bonneville in addition to the Opinion minimum and maximum flows.

It should be pointed out that requested flows for chum and bright fall chinook using the Ives/Pierce Island areas below Bonneville Dam were not met in October of 2000. As a result of the power emergencies in June and August of 2000, operators did not feel that reservoir conditions could provide adequate flows during the mentioned months. However, later in the season, during the winter months, water was released from the reservoirs as the demand and resulting price for electricity was high. Therefore, flows for chum salmon between November and April may have been entirely coincidental with outputs for power generation.

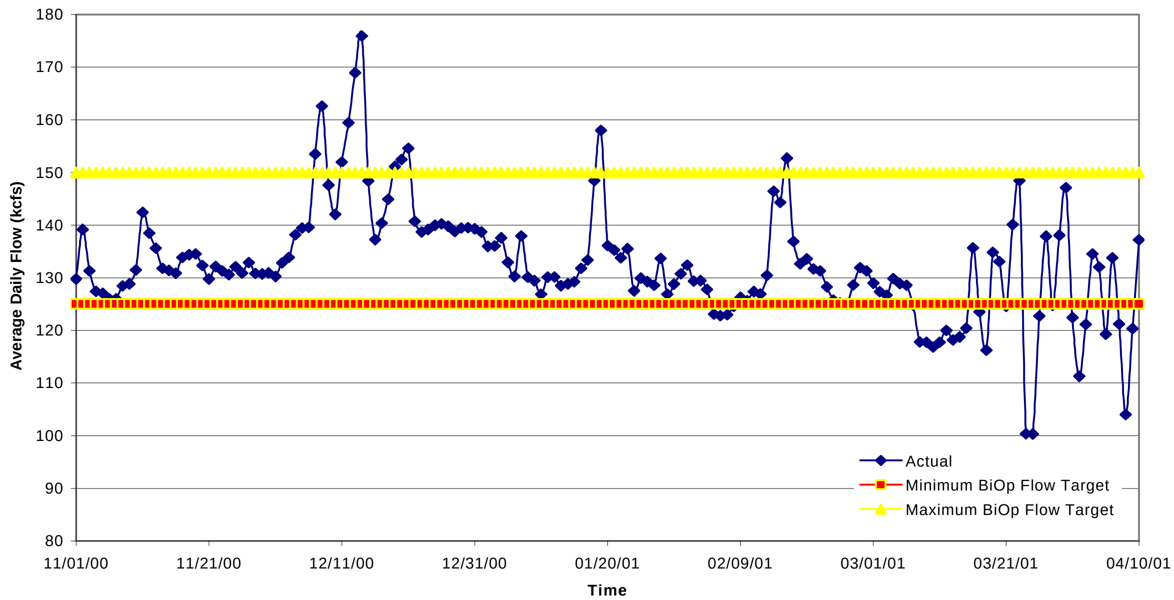

FIGURE 12. The Opinion minimum and maximum flow objectives and the actual flows between November 1st and April 10th, 2001 at Bonneville.

3. Canadian Projects

Arrow

Arrow began the 2001 Water Year at 1430.2 feet AMSL. From the beginning of October to December 2nd, the water surface elevation at Arrow increased only 1.9 feet, increasing to 1432.1 feet AMSL. During this period, inflows averaged 37.8 Kcfs and outflows 35.8 Kcfs. From December 3rd to May 22nd the Arrow Reservoir drafted water to an elevation of 1385.2 feet AMSL. During this period, inflows averaged 28.8 Kcfs and outflows averaged 43.5 Kcfs. From May 23rd to August 3rd, 2001, the Arrow Reservoir refilled to and elevation of 1412.2 feet AMSL. Beyond August 3rd, Arrow was drafted to an elevation of 1399.8 feet AMSL on September 30th, 2001. Figure 13, demonstrates the operation of the Arrow Reservoir over the 2001 Water Year.

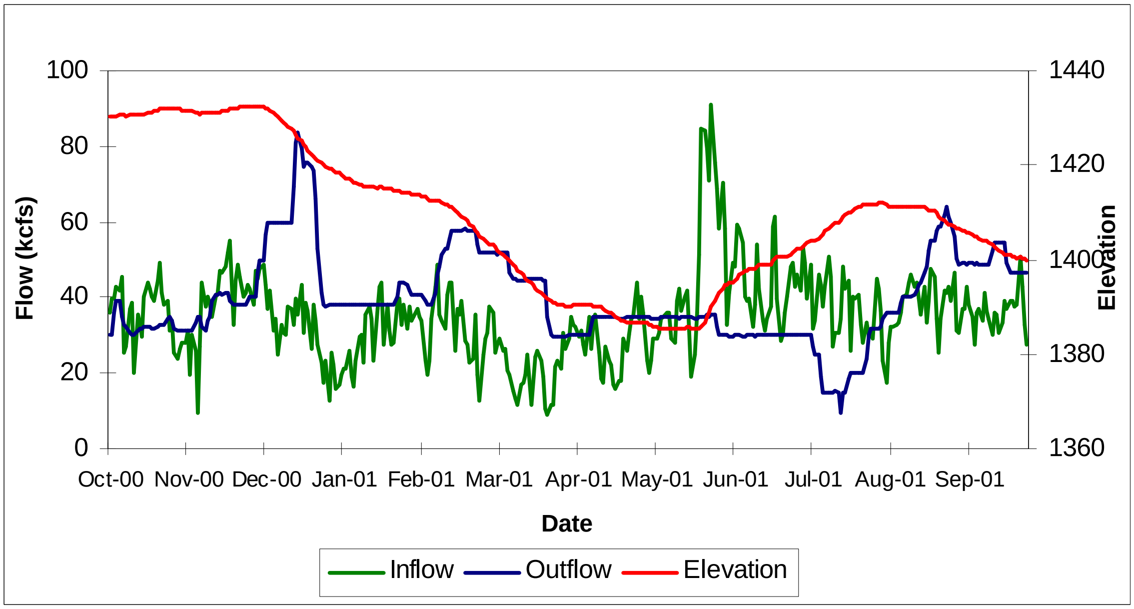

FIGURE 13. Inflows, outflows, and reservoir elevations at the Arrow Reservoir over Water Year 2001.

Duncan

Duncan began the 2001 Water Year at 1867.5 feet AMSL. From the beginning of October to January 13th, the Duncan Reservoir was drafted to an elevation of to 1794.4 feet AMSL. During this period, inflows averaged 1.1 Kcfs and outflows 5.8 Kcfs. From January 14th to April 20th the Duncan Reservoir water surface elevation remained steady, both inflows and outflows averaging 0.6 Kcfs. From April 21st to August 4th, 2001, the Duncan Reservoir refilled to an elevation of 1875.8 feet AMSL. Beyond August 4th, Duncan was drafted to an elevation of 1845.1 feet AMSL on September 30th, 2001. Figure 14, demonstrates the operation of the Duncan Reservoir over the 2001 Water Year.

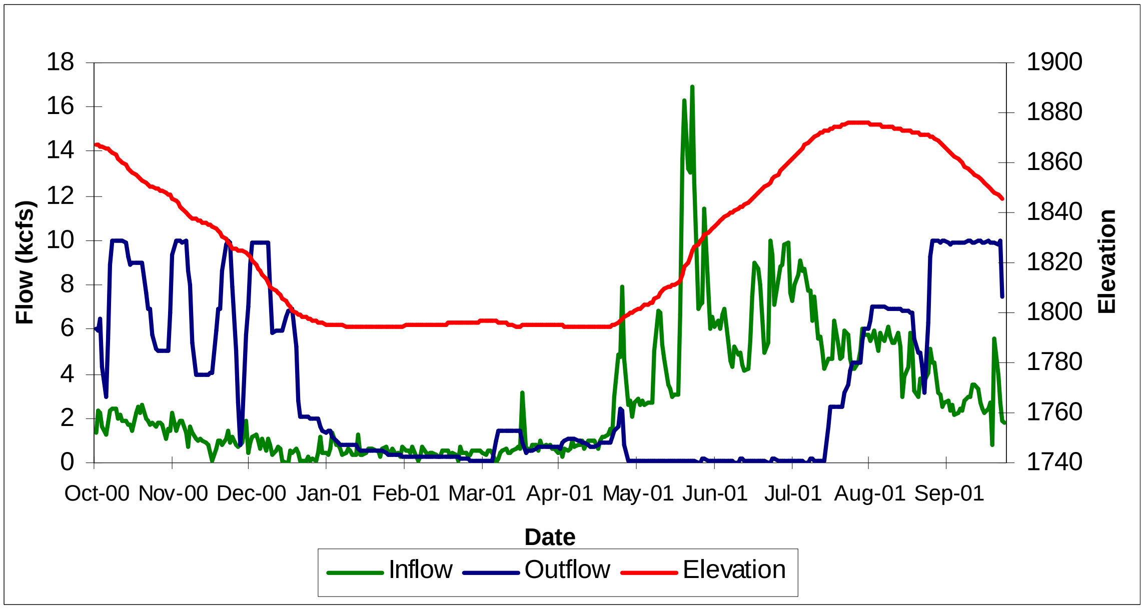

FIGURE 14. Inflows, outflows, and reservoir elevations at the Duncan Reservoir over Water Year 2001.

Mica

Mica began the 2001 Water Year at 2449.2 feet AMSL. From the beginning of October to April 26th, the Mica Reservoir was drafted to an elevation of to 2344.8 feet AMSL. During this period, inflows averaged 5.2 Kcfs and outflows 24.8 Kcfs. From to April 26th to September 3rd the Mica reservoir refilled to an elevation of 2435.2 feet AMSL. Beyond September 3rd, Mica was drafted to an elevation of 2429.1 feet on September 30th, 2001. Figure 15, demonstrates the operation of the Mica Reservoir over the 2001 Water Year.

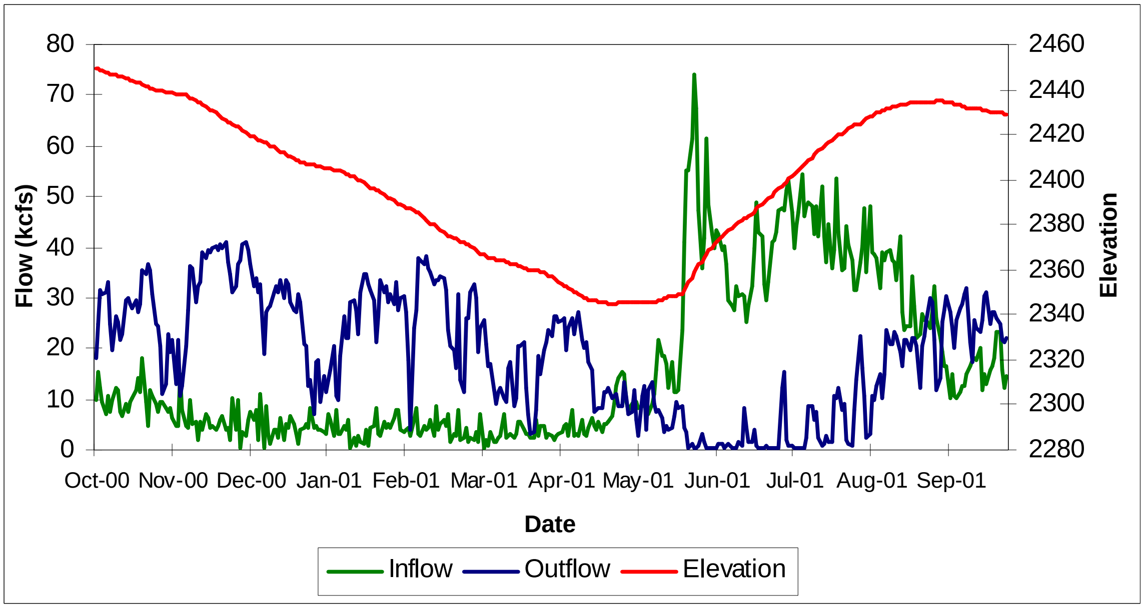

FIGURE 15. Inflows, outflows, and reservoir elevations at the Mica Reservoir over Water Year 2001.

D. Conclusions

- The overall operation of the hydrosystem during WY 2001 was focused upon power production and not upon Opinion measures.
- Monthly 2001 precipitation at the Columbia River above Grand Coulee, the Snake River above Ice Harbor, and the Columbia River above The Dalles averaged approximately 70% of average.
- The 2001 January-July runoff at The Dalles was the second lowest in Columbia River recorded history.
- The Brownlee storage reservoir operated near (i.e., 1.3 to 3.3 feet) its designated March and April flood control targets and its April 10th Opinion target elevation.
- The Brownlee Reservoir was very close (i.e., 1.5 feet) to its full pool elevation by June 30th of 2001, as suggested in the Opinion.
- The Dworshak Reservoir was drafted well below (i.e., up to 69.5 feet) its designated March and April flood control targets and its April 10th Opinion target elevation.

- Dworshak did not refill by June 30th of 2001; the full pool elevation at Dworshak is 1600 feet and the maximum actual elevation achieved was 1587.5 feet AMSL on July 1st, 2001.
- On August 31st, 2001, the Dworshak Reservoir was at an elevation of 1520.5 feet AMSL, just 0.5 feet above the Opinion maximum draft limit of 1520 feet AMSL.
- The Libby Reservoir was drafted well below (i.e., up to 61.0 feet) its designated March and April flood control targets.
- Libby did not refill by June 30th of 2001, as suggested in the Opinion.
- The actual elevation of Libby was 2434.9 on August 31st, 2001; 4.1 feet below the Opinion maximum draft limit of 2439 feet AMSL.
- The Grand Coulee Reservoir was drafted well below (i.e., up to 63.1 feet) its designated March and April flood control targets and its April 10th Opinion target.
- Grand Coulee did not refill by June 30th of 2001, as suggested in the Opinion.
- The actual elevation of Grand Coulee was 1278.3 on August 31st, 2001; 0.3 feet above the Opinion maximum draft limit of 1278.0 feet AMSL.
- The Hungry Horse Reservoir was drafted well below (i.e., up to 66.4 feet) its designated March and April flood control targets and its April 10th Opinion target.
- Hungry Horse did not refill by June 30th of 2001,as suggested in the Opinion.
- The actual elevation of Hungry Horse was 3539.4 on August 31st, 2001; 0.6 feet below the Opinion maximum draft limit of 3540.0 feet AMSL.
- The average spring flows at Lower Granite from April 3rd to June 20th, 2001 were 47.5 Kcfs, well below the Opinion target of 85 Kcfs.
- The average summer flows at Lower Granite from June 21st to August 31st, 2001 were 25.4 Kcfs, well below the Opinion target of 50 Kcfs.
- The average spring flow at Priest Rapids between April 10th and June 30th were 76.7 Kcfs, well below the Opinion target of 135 Kcfs.
- The average spring flow at McNary between April 10th and June 30th was 123.9 Kcfs; again, well below the Opinion target of 220 Kcfs.
- The summer flow objective at McNary was 200 Kcfs between July 1st and August 31st; in 2001, the average flows at McNary during this time period were 90.9 Kcfs.

II. 2001 Spill Management

A. Spill

1. Overview

An ESA Section 7 Biological Opinion on the operation of the Federal Columbia River Power System was issued in March of 1995. The Opinion established a set of reasonable and prudent alternatives with the objective of improving the operation and configuration of the federal power system to meet a no jeopardy requirement of the Endangered Species Act (ESA), and to fulfill the United States commitment to uphold tribal treaty fishing rights. One of the RPA established a Biological Opinion spill program for fish passage.

In May of 1998, the NMFS issued a Supplemental Biological Opinion (Supplemental Opinion) to the Biological Opinion signed on March 2, 1995. The Supplemental Opinion was developed in part to address the needs of the newly listed as threatened Snake River steelhead and the Lower Columbia River steelhead, as well as the endangered Upper Columbia River steelhead. The Supplemental Opinion called for additional spill to the gas caps on a system-wide basis to provide further benefits to steelhead, while also increasing the survival of Snake River spring/summer and fall chinook and sockeye. To the extent that the fish passage efficiency (FPE) at some projects will exceed 80%, this additional spill supplements 1995 RPA Measure 2 for an interim period pending decisions regarding biologically based performance standards for project passage.

The Supplemental Opinion also modified the planning dates for the initiation and duration of the spill program. The planning dates start spill earlier in both the Snake and lower Columbia rivers, with the actual initiation of the spill program dependent on the presence of juvenile migrants based on in-season fish monitoring information.

The NMFS again modified spill in the 2000 Opinion issued in December of 2000. In the 2000 Opinion, spill at Lower Monumental Dam was increased from a 12-hour period to a 24-hour period. At The Dalles Dam the instantaneous spill level was decreased significantly from 64% of instantaneous flow to 40% of instantaneous flow. Spill at John Day and Bonneville dams remained unchanged from the 1998 Supplemental Opinion, but the Spill Plan Agreement called for the initiation of a daytime spill test at John Day Dam and a test of increasing daytime spill volume at Bonneville Dam.

The purpose of the spill program is to improve the downstream passage of ESA listed stocks by providing a route with less associated mortality than turbine passage. It is recognized that spilling water generates atmospheric gas supersaturation in the river that can have detrimental effects on fish. In providing spill as an alternate passage route the associated mortality due to dissolved gas supersaturation needs to be balanced against mortality of turbine passage. In most near normal and above normal water years the cost to implement spill is mostly absorbed by excess generation and excess hydraulic capacity spill (see past years' FPC Annual Reports). However, in 2001 the cost of spill was at the center of most all the pre-season and in-season discussions that occurred.

The average monthly flows that occurred at Lower Granite and McNary Dams are contained in Table 8.

TABLE 8. Average monthly flows at Lower Granite and McNary dams in 2000 & 2001.

Month	Average Monthly Flow (kcfs)			
	Lower Granite		McNary	
	2000	2001	2000	2001
April	90.2	35.1	254.9	107.7
May	84.1	63.2	255.4	129.6
June	68.4	35.7	206.4	158.0
July	37.8	26.6	166.7	84.9
August	25.9	23.8	140.4	96.8

2. Spill Planning

Spill planning in 2001 was significantly different than what occurred in past years'. Early in the year it was apparent that the runoff volume for the 2001 water year would be significantly below average. In early February of 2001, the BPA developed and presented to the region its proposed contingency operations for the hydrosystem based on an early forecast that runoff volume at The Dalles was predicted to be 63% of average. These operations included a reduced spring/summer spill program.

BPA declared a power emergency on February 12 that lasted through February 20th. During February and March BPA presented the results of several different studies they conducted illustrating the difficulty they were facing for maintaining financial solvency and meeting firm load given the power system reliability and west coast power prices and the requirements of meeting Opinion mitigation measures. Spill for fish passage was particularly contentious in these discussions because of its direct cost in terms of foregone power generation.

On April 3 BPA again declared a Power Emergency that was in place for the rest of the Opinion period. No spill was proposed for the near term based on the Northwest Power Planning Councils' (NPPC) identification of potential power system reliability problems during the spring and summer of 2001, as well as the impact of spill for fish passage on West coast energy prices and power system reliability. However, at the April 28th Regional Executives meeting BPA agreed to develop contingency proposals for spill implementation at specific megawatt month levels (200, 400, 600 and 800 MW months). Discussions continued throughout the early part of May regarding the ability to implement a modified-reduced spill program. The implementation of spill was dependent on the resolution of a "spill swap" agreement between the federal hydrosystem and the Grant County Public Untility District (PUD). The "spill swap" agreement provided for reduced spill in the federal hydrosystem during May; however, if the water supply decreased then Grant County PUD would reduce its summer spill to account for the reduction of runoff. This agreement had to be approved by the Federal Energy Regulatory Commission (FERC) before it could be implemented.

The BPA Administrator made the decision to go forward with spill implementation prior to approval by FERC, and spill began at Bonneville and The Dalles dams on May 16th. The limited spill program was scheduled to last for an equivalent of 300 MW-months, which was estimated at 19 days. On the evening of May 25th McNary and John Day dams were added to the spill program (estimated to reach 300 MW months and end on June 2, 2001). On June 1 the Federal Executives agreed to go beyond the 300 MW months and extend spill to 600 MW-months, which was estimated to end on June 15th. The FERC approved the "spill swap" between BPA and Grant County PUD during this period. Spring spill in the lower Columbia River ended at midnight on June 15th.

A summer spill program was discussed in mid and late June and rejected by BPA because reliability criteria could not be met. Considerable concern was raised regarding the power system reliability for the upcoming summer, fall and winter. Discussions continued through mid July based on the biological benefits for fish from the spill action. A total of 200 MW-months of spill was provided to TMT to develop details for implementation. Summer spill occurred at The Dalles and Bonneville dams. The spill program continued until August 31 and subsequently totaled 411 MW-months based on improved summer storage accomplished by BPA, which lead to a lower reliability risk.

The decision to spill in 2001 was made well into the spring and summer migrations. Subsequently, while spill did provide protection to a proportion of the run, it did not provide protection to a large segment of the run.

3. Total Dissolved Gas Waivers

In 2001, a waiver of the water quality standard for total dissolved gas supersaturation (TDGS) was granted. Unlike past years when the NMFS made the request, the waiver was granted to the US Army Corps of Engineers. Because of the risk associated with dissolved gas supersaturation, the requested waiver was for a twelve-hour average of 115 and 120 percent TDGS in the forebay and tailrace of a project, respectively. The waivers were granted for the 2001 season by the Oregon and Washington state water quality agencies. No spill waiver was provided by the State of Idaho or the Nez Perce Tribe for the 2001 fish migration. Therefore, total dissolved gas levels were limited to the 110% level in these jurisdictions.

4. Spill Implementation

Snake River

The water conditions during 2001 were significantly below average in terms of volume runoff. Spring flows in the Snake River were predicted to be less than the average of 85 Kcfs. Under these conditions the Opinion calls for the suspension of spill at the transport collector projects (Lower Granite, Little Goose and Lower Monumental dams) and for the maximization of transportation. Consequently, no spill occurred at these projects. In addition, due to the declared power system emergency spill was suspended at Ice Harbor Dam as well.

Ice Harbor Dam

The Opinion specifies an instantaneous spill level of 45 Kcfs during the day and 100 Kcfs during the night from April 3 through August 31 (planning dates). In 2001 spill at this project was suspended throughout the spring and summer migrations due to the declared power emergency.

Lower Columbia River

The 2001 water year was also significantly below average in the lower Columbia River. The need for spill was discussed through the beginning of the spring migration after BPA declared a continuing power emergency on April 3, 2001. As a result of several meetings among the federal executives there was agreement to implement modified spring and summer spill programs at specific megawatt-month levels. As discussed previously, spill in 2001 was accounted for on the basis of MW-months of energy.

McNary Dam

The 2000 Opinion calls for spill at McNary Dam at a level equal to 50% of instantaneous discharge (up to the 120% TDGS gas cap, estimated at between 120-150 Kcfs) for a 12-hour period daily between April 10 and June 30 (planning dates). Spill in 2001 occurred beginning on the evening of May 25th and continued through midnight on June 15th. Spill was equal to an instantaneous level of 30 Kcfs from 1800 to 0600 hours on an every other night basis. On the non-spill days, transportation occurred from this project. The 2000 Opinion does not call for spill at McNary during the summer period.

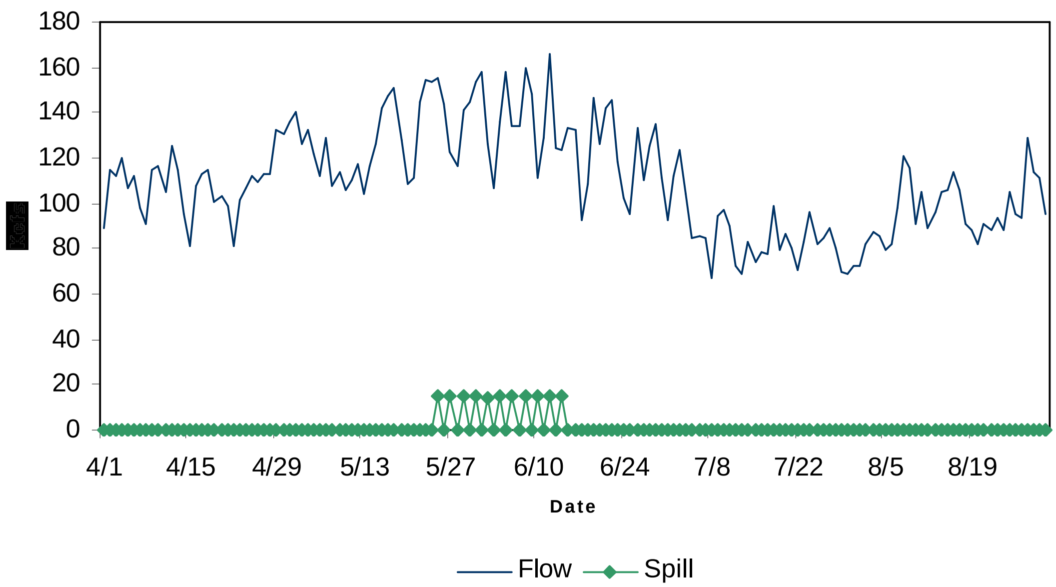

FIGURE 16. McNary Dam Daily Average Flow and spill 2001.

John Day Dam

According to the Opinion spill at John Day Dam should be to the gas cap, limited to 60% of total flow below 300 Kcfs for tailrace conditions, and is expected to vary between 85 and 160 Kcfs for 11 to 12 hours nightly between April 10 and August 31 (planning dates). Spring spill in 2001 occurred between May 25 and June 15 and no summer spill occurred.

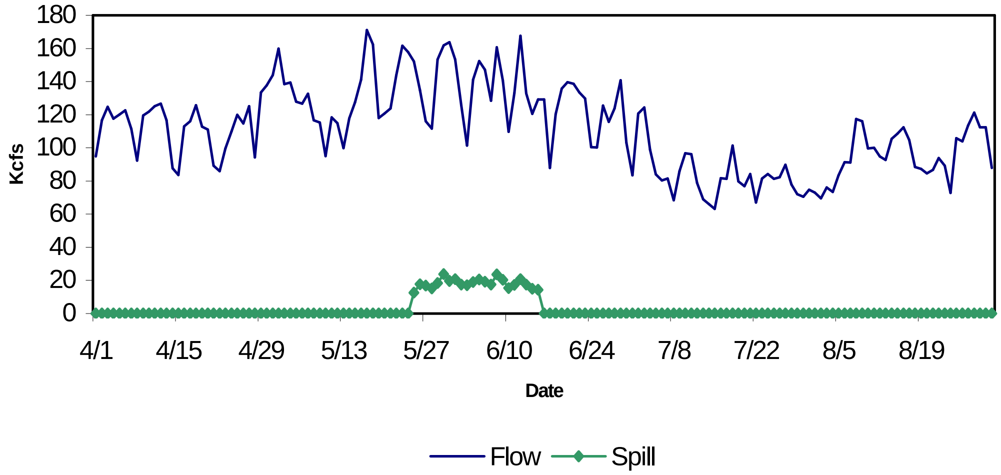

FIGURE 17. John Day Dam Daily Average Flow and Spill 2001

The Dalles Dam

According to the Opinion spill at The Dalles should equal 40% of instantaneous floe for 24 hours during the spring and summer (April 10 through August 31). In 2001 spill was provided during the spring between May 16 and June 15th at a level approximately equal to 30% of instantaneous flow. Summertime spill for fish passage in 2001 was provided at The Dalles between July 24 and August 31 at a level approximately equal to 30% of instantaneous flow.

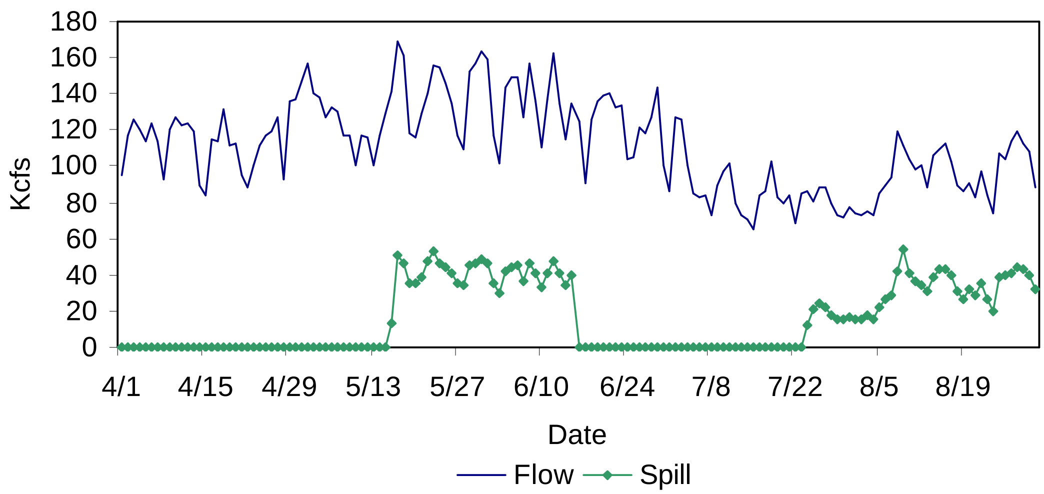

FIGURE 18. The Dalles Dam Daily Average Flow and Spill 2001

Bonneville Dam

Spring Creek Hatchery Release

The Oregon Department of Environmental Quality (DEQ) granted a waiver request for a variance of the total dissolved gas standard below Bonneville Dam from the USFWS for the 10-day spill period associated with the Spring Creek Hatchery tule fall chinook release, as did the Washington Department of Ecology (DOE). The Spring Creek Hatchery tule fall chinook are an important buffer to ESA listed stocks present in ocean and Columbia River mixed stock fisheries. Spill has been provided annually for this stock because of its importance to fisheries. In the past spill has been provided up to the 120% TDGS gas cap for a period of between five and ten days dependent on the juvenile fish passage at the project.

Spill was originally requested at an instantaneous level of 55 Kcfs for a period of up to 10 days, taking into account the much lower flows in 2001 and the potential for elevated total dissolved gas levels with insufficient depth compensation over the redds for emergent fall chinook in the Ives/Pierce Island complex below the Bonneville Project. Initially Bonneville Power Administration would only agree to a level of 50 Kcfs for a 24-hour period, based on the power and economic emergency situation. After consideration, BPA agreed to 3 12-hour periods of spill at the level of 50 Kcfs. The fish were released from Spring Creek Hatchery on March 8th. Spill occurred the evenings of March 10th, 11th and 12th. The non-spill operations requested for the release were continued through March 19th.

According to the Opinion spill at Bonneville Dam is to be provided during the spring and summer (April 10 through August 31) at a rate up to the 120% gas cap during nighttime hours (90-150 Kcfs) and 75 Kcfs during daytime hours. During the 2001 spring period (May 16 to June 15) spill occurred at a level equal to 50 Kcfs per hour for a 24-hour period daily. Spill during the summer months was equal to 45 Kcfs (July 24 - August 31) for 5 hours nightly (2100 hours to 0100 hours the next day) until August 10th when the hours were modified so that spill occurred for 24 hours daily until August 31st.

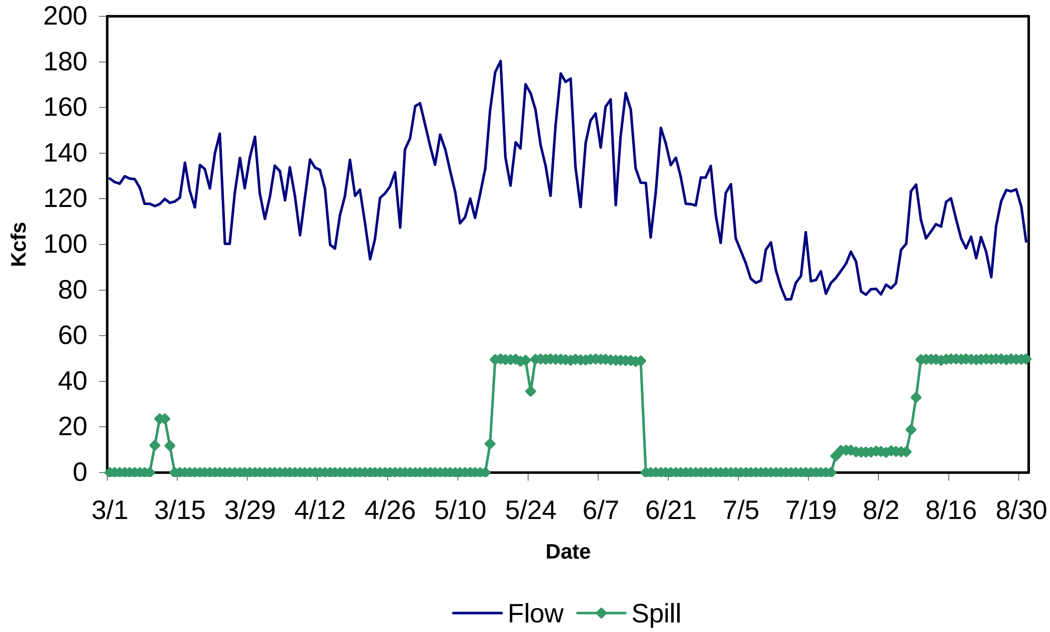

FIGURE 19. Bonneville Daily Average Flow and Spill 2001

5. Spill Survival

<u>Yearling chinook reach survival estimates from McNary Dam Tailrace to Bonneville Dam Tailrace</u>

Most PIT tagged yearling chinook and steelhead passage occurred at McNary Dam between May 1 and June 9 in 2001. During this time there were 138,205 PIT tagged yearling chinook and 5,328 PIT tagged steelhead detected at McNary Dam on a route that confirmed they were returned to the river. The PIT tagged yearling chinook were blocked into nine multi-day passage groups, spanning May 1-10, May 11-15, May 16-18, May 19-21, May 22-23, May 24-25, May 26-27, May 28-30, and May 31-June 9. The Cormack-Jolly-Seber (CJS) methodology was used with McNary Dam considered the release location and John Day Dam, Bonneville Dam, and the NMFS trawl in the Jones Beach section of the lower Columbia River as three recovery sites. Release numbers per block ranged between 11,883 and 25,778 and provided detection numbers in the trawl between 137 and 301 fish (average 220), large enough to provide survival estimates in the lowest reach between John Day Dam tailrace and Bonneville Dam tailrace with standard errors (c-hat adjusted) <0.14. The c-hat adjustment increases the CJS theoretical variance to compensate for over-dispersion in the data relative to the underlying multinomial model. The product of two reach survival estimates (McNary Dam tailrace to John Day Dam tailrace survival estimate and John Day Dam tailrace to Bonneville Dam tailrace survival estimate) produced the overall survival estimate from McNary Dam tailrace to Bonneville Dam tailrace. The estimates of these survival parameters are negatively correlated (i.e., if survival in the upstream reach is overestimated, then the survival in the downstream reach will be underestimated), and so the variance of S1*S2 was computed using Meyer's (1975) formula var (S1*S2) = (S1*S2)2 {var(S1)/(S1)2+var(S2)/(S2)2+2cov(S1,S2)/(S1*S2)}. The computation used the identity cov(S1,S2) = se(S1)*se(S2)*correlation(S1,S2). Both season unweighted and weighted averages are computed. A seasonal weighted average is generated using the inverse relative variance of each estimate as a weight, i.e., wj=1/(se(Sj))2/Sj2= Sj2/(se(Sj))2.

TABLE 9. Yearling chinook survival estimate from McNary Dam tailrace to Bonneville Dam tailrace, 2001

Date Range	S	se(S)
5/1-5/10	0.3978	0.0470
5/11-5/15	0.5477	0.0852
5/16-5/18	0.5069	0.0661
5/19-5/21	0.5261	0.0817
5/22-5/23	0.6437	0.0804
5/24-5/25	0.5969	0.0615
5/26-5/27	0.6755	0.0783
5/28-5/30	0.5690	0.0990
5/31-6/9	0.4830	0.1249
Weighted mean	0.5598	0.0309
Simple mean	0.5496	0.0282

Whenever the survival estimates of the groups released over time do not significantly differ, a single seasonal average is a logical summary statistic. However, if significant differences occur over time, then it is important to present these differences and investigate potential influencing factors. To determine if any significant differences occurred within a year, a test of whether the "between group" variance component was significantly greater than zero (Burnham 1987 et al., Chapter 4). This is a chi-square test equal to [empirical variance of mean survival*(1-degrees of freedom)]/ [theoretical variance of mean survival]. In cases where the chi-square test was not significant at the 95% confidence level, then the average was computed for the season; otherwise, the season was split into periods showing the different survival levels. The chi-square test value of 8.25 was not significant (less than the significance level of X [8 df, 0.05] = 15.51), and so temporal differences were not greater than what is expected by random chance.

Yearling chinook reach survival estimates from McNary Dam tailrace to John Day Dam tailrace in 2001

Although the overall reach did not show signs of significant differences over time, the shorter reach from McNary Dam tailrace to John Day Dam tailrace was emerging as a reach were differences may be occurring. Within the shorter reach, the release numbers per block were providing detection numbers at Bonneville Dam between 1,657 and 2,959 fish (average 2,137), large enough to provide survival estimates in the reach between McNary Dam tailrace and John Day Dam tailrace with standard errors (c-hat adjusted) <0.063.

TABLE 10. Yearling chinook survival estimate (S) from McNary Dam tailrace to John Day Dam tailrace, 2001, along with estimated collection efficiency (ce) at John Day Dam.

Date Range	S	se(S)	ce	se(ce)
5/1-5/10	0.7660	0.0195	0.4306	0.0116
5/11-5/15	0.8148	0.0240	0.4133	0.0105
5/16-5/18	0.7647	0.0265	0.3336	0.0094
5/19-5/21	0.8080	0.0341	0.2980	0.0101
5/22-5/23	0.8505	0.0373	0.1822	0.0088
5/24-5/25	0.9322	0.0363	0.1916	0.0073
5/26-5/27	0.8418	0.0267	0.2512	0.0088
5/28-5/30	0.9326	0.0625	0.1809	0.0090
5/31-6/9	0.9268	0.0536	0.2138	0.0074
Weighted mean	0.8238	0.0204	------	-------
Simple mean	0.8486	0.0226	0.2772	0.0325

Estimated survival of yearling chinook from McNary Dam tailrace to John Day Dam tailrace in 2001 ranged from around 76% early in the season to around 93% late in the season. The chi-square test value of 25.47 was significant (greater than the significance level of X [8 df, 0.05] = 15.51), and so temporal differences were greater than what is expected by random chance. This lead to the need to determine during which date ranges the significant changes in survival were occurring. As shown in Figure 20, the first four periods through May 21 appeared to have lower survival than during the next five periods. Chi-square tests of the temporal survival estimates within each of these two extended periods showed non-significant values of 3.04 (less than the significant level of X [3 df, 0.05] = 7.81) and 4.21 (less than the significant level of X [4 df, 0.05] = 9.49), respectively. It was apparent that the migration was split into two extended blocks of time, pre- and post-May 21, during which survival was fairly homogenous within the temporal block but significantly different between temporal blocks. The collection efficiency at John Day Dam for also was showing a difference between the pre-May 21 and post-May 21 temporal blocks (Table 10 and Figure 20), dropping from 43% to 30% during the first four periods, and fluctuating between 18% and 25% during the last five periods. For the four periods through May 21 and five

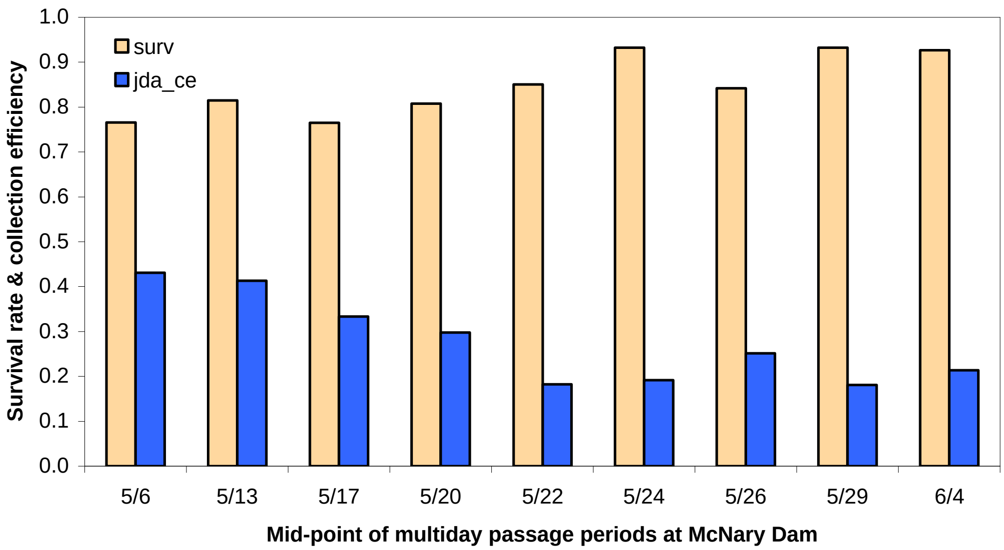

FIGURE 20. Yearling chinook survival from McNary Dam tailrace to John Day Dam tailrace and collection efficiency at John Day Dam in 2001

periods after May 21, 2001, the unweighted mean survival estimate for yearling chinook from McNary Dam tailrace to John Day Dam tailrace was 78.8% and 89.7%, respectively (Table 11 and Figure 21). This reflects an approximate 14% increase in survival between the pre- and post-May 21 temporal blocks. The collection efficiency at John Day Dam for yearling chinook dropped from an average of 37% to 20% between the pre-May 21 and post-May 21 temporal blocks (Table 11). The question of whether this same trend in survival and collection efficiency was occurring with steelhead was also investigated.

TABLE 11. Yearling chinook and steelhead survival estimates (S) from McNary Dam tailrace to John Day Dam tailrace, 2001, along with estimated collection efficiency (ce) at John Day Dam (unweighted mean estimates for yearling chinook; single point estimates for steelhead).

Date Range	Blocks	S	se(S)	ce	se(ce)
YEARLING CHINOOK					
5/1-5/21	4	0.7884	0.0134	0.3689	0.0317
5/22-6/9	5	0.8968	0.0207	0.2039	0.0132
STEELHEAD					
5/1-5/21	1	0.3138	0.0201	0.3993	0.0291
5/22-6/9	1	0.3807	0.0563	0.0963	0.0164

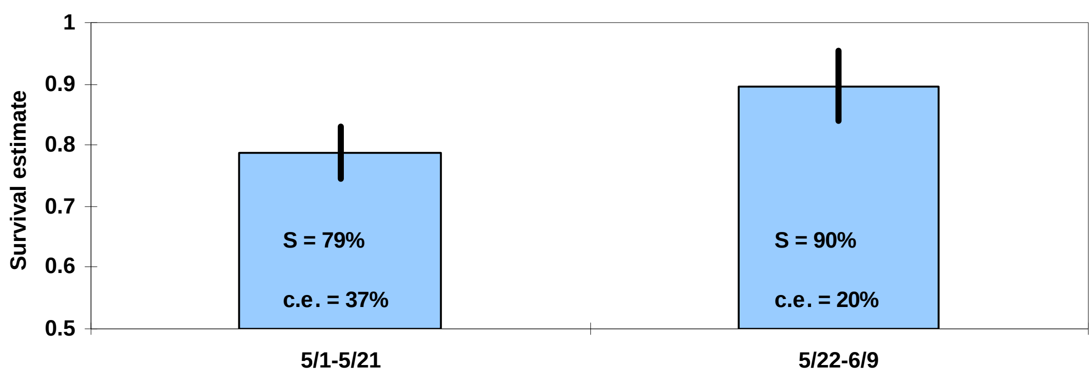

FIGURE 21. Yearling chinook survival from McNary Dam tailrace to John Day Dam tailrace in 2001

Steelhead reach survival estimates from McNary Dam tailrace to John Day Dam tailrace in 2001

Because the number of PIT tagged steelhead passing McNary Dam in 2001 was only about 4% of the number of PIT tagged yearling chinook, it was not possible to create more than a couple of periods over the steelhead migration season. Therefore a pre- and post-May 21 set of periods was established for steelhead with 2,163 PIT tagged steelhead in the May 1-21 period and 3,165 PIT tagged steelhead in the May 22-June 9 period. These release numbers for the two blocks were providing detection numbers at Bonneville Dam of 272 and 308 fish, respectively, large enough to provide survival estimates in the reach between McNary Dam tailrace and John

Day Dam tailrace with standard errors <0.057. The point estimate of survival estimate for steelhead from McNary Dam tailrace to John Day Dam tailrace was 31.4% and 38.1%, respectively, in the pre- and post-May 21 temporal blocks (Table 10 and Figure 20). This reflects an approximate 21% increase in survival between the two blocks, which was 7 percentage points higher than estimated for yearling chinook. The collection efficiency at John Day Dam for steelhead dropped from 40% to 10% between the pre-May 21 and post-May 21 temporal blocks (Table 10).

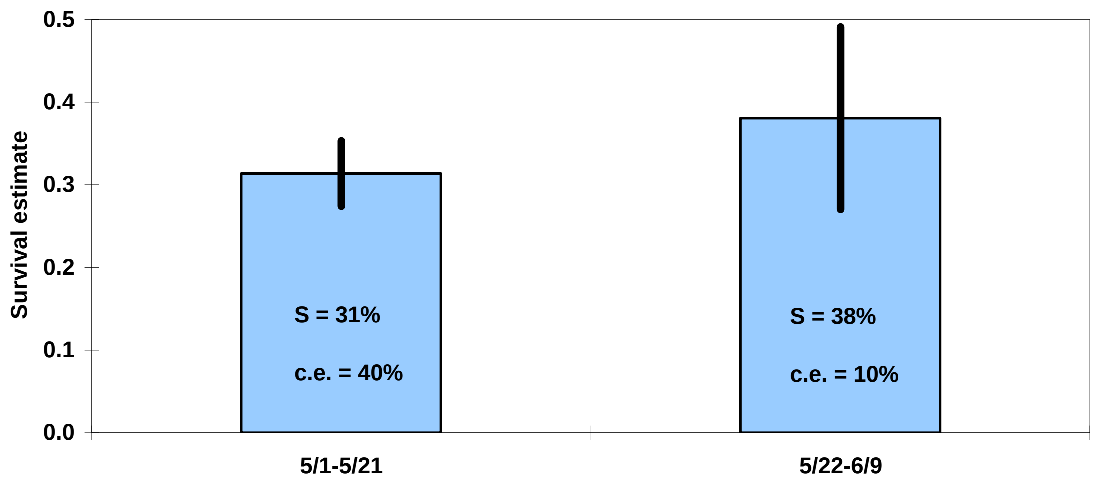

FIGURE 22. Steelhead survival from McNary Dam tailrace to John Day Dam tailrace in 2001.

Effects of John Day Dam spill on smolt survival in 2001

It was apparent that both yearling chinook and steelhead passing McNary Dam after May 21 experienced conditions that improved their in-river survival. No spill occurred at John Day Dam in 2001 prior to May 25, so nearly all yearling chinook and steelhead passing McNary Dam between May 1 and May 21 would pass John Day Dam before the spill commenced. Most yearling chinook and steelhead passing McNary Dam between May 22 and June 9 would pass John Day Dam during the spill period of May 25 to June 15. Spill volume during the 22-day spill period average 13.2% of the daily average flow at John Day Dam (Table 11). Estimated collection efficiency dropped approximately 45% for yearling chinook and 75% for steelhead when the third route of passage, i.e., spill, was added between May 25 and June 15 (see Table 10), indicating that during this time many smolts would now be using the spill route of passage. So even though the proportion of spill at John Day Dam was relatively low (averaging 13.2%), there appears to be a large movement of both yearling chinook and steelhead passing through the spill route under the extremely low flow conditions (averaging 138 Kcfs) in the lower Columbia River at that time. Average flows in the lower Columbia River remained fairly similar for yearling chinook and steelhead passing McNary Dam after May 1 (Table 12). The lower average flows in April would be experienced by smolts originating in tributaries below McNary Dam that were migrating at that time. Which stocks were passing John Day Dam before and during the spill period of 2001 was the next question to address.

TABLE 12. Flow and spill conditions during springtime migration at John Day Dam in 2001.

Time period	Average Flow	Average Spill	Spill percentage
April 1 – April 14	113.7 kcfs	None	0.0%
April 15 – April 30	110.8 kcfs	None	0.0%
May 1 – May 24	132.3 kcfs	none	0.0%
May 25 – June 15	138.1 kcfs	18.2 kcfs	13.2%

Stocks affected by the springtime spill

Yearling chinook and steelhead stocks that originated in the Walla Walla, Umatilla and John Day rivers appeared to mostly pass John Day Dam in 2001 before the spill period commenced. The percent of PIT tagged yearling chinook from the Umatilla and John Day rivers detected at John Day Dam before the spill began was approximately 92% and 98%, respectively (Table 13). The percent of PIT tagged steelhead from the Walla Walla, Umatilla, and John Day rivers detected at John Day Dam before the spill began was approximately 87%, 87% and 92%, respectively (Table 14). Yearling chinook from the Yakima River basin and yearling chinook and steelhead originating in the Mid-Columbia River basin at or above Rock Island Dam had at least 50% of their detections during the spill period at John Day Dam. The PIT tagged chinook and steelhead from the Snake River basin also had detection percentages around 50% during the spill period. But since most unmarked chinook and steelhead were transported from the Snake River basin in 2001, there would be very few smolts from that basin passing John Day Dam in-river at any time in 2001.

TABLE 13. Proportion of PIT tagged yearling chinook detected at John Day Dam over specific periods of the 201 migration season. May 25-June 16 was the only spill period at John Day Dam in 2001.

Dates of PIT tag detections at John Day Dam	Snake R basin	Mid-Columbia R basin at/above Rock Island Dam[1]	Yakima R basin	Umatilla R basin	John Day R basin
Total detections	14,086	2,091	4,041	1,291	1,743
3/30 – 4/30	0.0002	0.0000	0.0084	0.1332	0.5295
5/1 – 5/24	0.3369	0.1836	0.3606	0.7854	0.4509
5/25 – 6/15	0.5422	0.6738	0.5048	0.0736	0.0132
6/16 – 9/15	0.1207	0.1425	0.1262	0.0077	0.0063

1 PIT tagged hatchery chinook released on alternating days at Rock Island and Rocky Reach dams in large numbers for specific studies were omitted because they do not represent the timing of the run-of-the-river fish.

TABLE 14. Proportion of PIT tagged steelhead detected at John Day Dam over specific periods of the 2001 migration season. May 25 - June 16 was the only spill period at John Day Dam in 2001.

Dates of PIT tag detections at John Day Dam	Snake R basin	Mid-Columbia R basin at/above Rock Island Dam	Walla Walla R basin	Umatilla R basin	John Day R basin
Total detections	440	59	23	1,005	97
3/30 – 4/30	0.0045	0.0000	0.0000	0.1124	0.3093
5/1 – 5/24	0.4841	0.1525	0.8696	0.7532	0.6082
5/25 – 6/15	0.3886	0.5254	0.0870	0.1085	0.0825
6/16 – 9/15	0.1227	0.3220	0.0435	0.0259	0.0000

B. Summary and Conclusions

In summary, spill provisions in 2001 were limited based on power system reliability needs. Juvenile survival through the power system was lower (see smolt survival section) than observed since PIT tag survival studies have been conducted. Significant increases in survival between McNary Dam tailrace and John Day Dam tailrace were observed for both yearling chinook and steelhead migrating past McNary Dam after May 21. This time is coincident with the initiation of spill at John Day Dam, demonstrating the benefit of spill to overall fish survival in the hydrosystem.

The decision to spill was made well into the fish migration season. Spill was provided too late to protect a significant proportion of the spring and summer migrants. The role and overall importance of spill in affecting the survival of juvenile migrants should be recognized and provisions to provide spill in every water year should be made. Specific comments on the 2001 spill season are:

- The provision of spill for fish released from the Spring Creek Hatchery continued to be contentious because they are hatchery fish released outside of the Biological Opinion spill program.
- Spill in the federal hydrosystem was based upon power system reliability and was limited in time and volume.
- Spill was shown to improve juvenile survival at John Day Dam based on PIT tag recaptures.
- The duration of the spill program was too short to afford protection to all stocks migrating through the lower Columbia River.
- With the lower fish guidance efficiency of the turbine intake screening devices (FGE) at dams such as John Day and Bonneville dams compared to those in the Snake River and McNary Dam, plus no screening devices at The Dalles Dam, spill is considered an important mitigation for increasing the survival of smolts migrating through the lower Columbia River hydro system.

C. Gas Bubble Trauma Monitoring and Data Reporting

1. Overview

Monitoring of juvenile salmonids in 2001 for gas bubble trauma (GBT) was conducted at Bonneville Dam and McNary Dam on the Lower-Columbia River, and at Rock Island Dam on the Mid-Columbia River. The Snake River monitoring sites were Ice Harbor Dam, Lower Monumental Dam, Little Goose Dam, and Lower Granite Dam. Sampling of fish began the first full week of April at all sites and continued through mid-June at the Snake River sites, when the numbers of steelhead and yearling chinook were too few to sample effectively. Subyearling chinook were not sampled in the Lower Snake River due to their endangered status and because the Opinion does not call for the implementation of summer spill at the Snake River collector projects. Sampling of subyearling chinook did occur at Columbia River sites to the end of August.

Sampling occurred two days per week at the Lower Columbia sites and once a week at Lower Granite, Little Goose and Lower Monumental in the Snake River. In previous years fish were sampled every other day (3 to 4 days per week) at most facilities. The number of sampling days was reduced in 1999, in order to decrease the number of fish handled. It was determined that the reduced sampling effort would not significantly diminish the capability to detect the presence of GBT in the migrating population.

The goal was to sample 100 salmonids of the most prevalent species (limited to chinook and steelhead) during each day of sampling at each site. Examinations of fish were done using a variable magnification (6x to 40x) dissecting scopes. The lateral line, both eyes, and unpaired fins were examined for the presence of bubbles. The bubbles present in the fins were quantified using a ranking system based on the percent area of the fins covered with bubbles. A rank of 0 was recorded when no bubbles were present; rank 1 was recorded when up to 5% of a fin area was covered with bubbles; rank 2 was for 6% to 25%; rank 3 indicated 26% to 50% fin area was bubbled; and rank 4 indicated greater than 50% of a fin was covered with bubbles. The left side lateral line was examined for the presence of bubbles. A similar ranking system to that used for the fins was used to assign a rank to the percent lateral line occluded. Based on the average number of lateral line scales in chinook and steelhead, the length spanned by 7 lateral line scales was equivalent to approximately 5% of the total length of the lateral line. The scale approximation was used as a guide to estimate percent occlusion. Then a rank was assigned based upon this approximation. It was assumed that few fish would have greater than 5% lateral line occlusion. The eyes of the fish were also examined and the eye with the highest amount of bubbles in it was ranked using the same criteria as was used for the fins. Additional information was recorded for each fish including, species, age, race, rearing disposition, fork length, fin clips, and tags. The examination procedures were similar to those used in past years of the program.

Sampling techniques varied somewhat based on the location. This year all sampling sites were at dams, where fish could be collected from the juvenile fish bypass system. At those dams where fish crossed separators the fish were collected as they entered the separator. At Bonneville Dam fish were collected from the bypass trap that was sampled every 30 minutes from 4 pm to midnight. Rock Island Dam is the only site where fish were held in a tank (up to 24 hours) prior to examination.

2. Results

A total of 12,634 juvenile salmonids were examined for GBT between April and August (Table 15). A total of 214 or 1.7% showed some signs of GBT in fins, eyes or lateral lines (Table 16).

TABLE 15. Number of juvenile salmonids examined for signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2001 as part of the GBT Monitoring Program.

	Site						
Species	BON	MCN	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	2,037	2,255	0	0	0	1,056	5,367
Chinook Yearlings	941	926	578	352	356	701	3,854
Steelhead	151	590	511	477	796	888	3,413
Total	3,129	3,771	1,089	829	1,152	2,664	12,634

Fin signs were found in 9 or 0.1% of the fish sampled at all sites. The fin signs were all rank 1 meaning less than 5% fin area affected. The prevalence of GBT signs at Rock Island Dam was higher than any other Columbia River site during the 2001 monitoring season. Because the Rock Island data may obscure other interannual trends in the occurrence of GBT signs among sites, it will be treated separately in the remainder of this report.

TABLE 16. Number of juvenile salmonids found with any signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2001 as part of the GBT Monitoring Program

	Site						
Species	BON	MCN	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	1	18	0	0	0	12	31
Chinook Yearlings	0	39	3	0	0	46	88
Steelhead	0	44	1	0	1	49	95
Total	1	101	4	0	1	107	214

The percent of fish with any signs of GBT in 2001 of 0.1% was the lowest total since the monitoring began in 1995. At Lower Columbia River and Snake River sites (i.e. excluding Rock Island) a total of 9,970 fish were examined with 107 (0.1%) exhibiting signs of GBT, compared to 0.2% in 2000, 1.4% in 1999, 1.6% in 1998, 4.3% in 1997, 4.2% in 1996 and 1.3% in 1995.

A total of 1 (0.001%) fish from the Lower Snake and Lower Columbia rivers showed fin signs. The fin sign found in 2001 was the lowest since monitoring began in 1995. The percent signs over the past several years has been 0.2% in 2000, 0.3% in 1999, 1.0% in 1998, 3.2% in 1997 and 3.3% in 1996. No severe fin GBT was found in Lower Snake and Lower Columbia sampling. This is similar to 2000 and 1995 when no severe fin GBT was found. Other years showed higher incidence of severe fin GBT; in 1998 four (0.01%) fish displayed severe fin signs, 1997 when 117 fish (0.27%) had severe fin signs (again exluding Rock Island) and 47 fish (0.12%) in 1996 while in 1999 no severe signs were found..

The Opinion Spill Program was managed using the data collected for total dissolved gas levels. However, signs of GBT in fins of juvenile fish, examined as part of the biological monitoring, were used to compliment the physical monitoring program. The NMFS set the action criteria for the biological monitoring program at 15% prevalence of fish having fin signs or 5% with severe signs (rank 3 or greater) in fins. The NMFS action criteria were never exceeded in 2001 (based on dates when at least 30 fish of the species exhibiting signs were sampled). There were no exceedences of the NMFS action criteria in 2000, 1999 or 1998, but 23 dates when GBT levels surpassed the action criteria in 1997, 20 in 1996, and there were no exceedences in 1995.

The prevalence and severity of fin signs in juvenile salmonids sampled in the Lower Snake and Lower Columbia rivers from 1995 to 2001 reflected changes in TDGS conditions in the river from year to year. In 1995 no fish had severe fin GBT and 1995 had the lowest number of days with high TDGS (Table 17). Also the occurrence of severe signs in 1996 and 1997, and the increase in exceedences of the NMFS action criteria, reflected a significant increase in the number of days when TDGS rose above 125% in the forebays of these dams (see Table 17 and Table 18). While in 1998 only 4 fish were found with severe fin GBT and 1 fish in 1999, reflecting the more moderate conditions found in the river.

TABLE 17. The number of days when TDSG levels were above 120% and 125% at representative forebay monitors in the Lower Snake and Lower Columbia Rivers from April 1 to August 31.

	2001		2000		1999		1998		1997		1996	
TDGS Monitor	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days > 125	days >120	days >125	days >120	days >125
Lower Granite	0	0	0	0	0	0	0	0	0	0	0	0
Little Goose	0	0	0	0	5	0	8	3	23	8	29	6
Lower Monumental	0	0	0	0	7	2	14	8	61	31	64	33
Ice Harbor	0	0	1	0	5	1	14	4	52	19	41	11
McNary (Oregon)	0	0	0	0	3	0	0	0	46	0	30	4
John Day	0	0	0	0	0	0	7	0	47	15	33	11
Bonneville	0	0	0	0	0	0	3	0	65	27	45	6
Total	0	0	1	0	20	3	46	16	294	100	242	60

TABLE 18. The number of days when NMFS GBT criteria of 15% prevalence or 5% severe signs were exceeded at sites in the Lower Snake and Lower Columbia rivers from April 1 to August 31.ab

Site	2001	2000	1999	1998	1997	1996
Lower Granite	0	0	0	0	0	0
Little Goose	0	0	0	0	1	1
Lower Monumental	0	0	0	0	7	9
Ice Harbor	0	0	0	0	3	2
McNary	0	0	0	0	2	1
John Day	0	0	0	0	1	4
Bonneville	0	0	0	0	11	4
Total	0	0	0	0	25	21

a Based on dates when at least 30 fish of the species exhibiting signs were captured.

b More than 5% of fish showed severe signs on only 1 date in each year 1996 & 1997 and on those same dates the prevalence of fin signs was greater than 15%.

This year, as in previous years, the proportion of fish showing fin signs appears to be proportional to the levels of TDGS experienced by fish. Also, Rock Island Dam continues to have the highest proportion of fish with signs of GBT versus TDGS levels in the reach of river above the dam.

With such low spill volume there was no time at which total dissolved rose above 120% as measured at forebay monitors (See Table 17). Indeed with such low gas levels as seen in 2001 it would be unlikely that TDGS levels had much impact upon the migrant salmonids. While the low percentage of fin signs reflect these conditions, with only 1 fish in the Lower Columbia or Snake showing a fin bubble, there were 106 fish with lateral line bubble this season. Oddly this number is similar when compared to other years. Over the years approximately 1% of fish examined show signs of GBT. It is surprising, given the low levels of TDGS seen in 2001 that such a relatively large number would be seen with lateral line signs. This suggests that lateral line signs are a less than ideal indication of exposure to high TDGS. Bubbles in the lateral line can be found when gas levels are very low. McNary forebay TDGS never exceeded 115% during the season, and yet at that location 101 fish were found with lateral line bubbles, while no fish were found with fin bubbles. While the proportion fin signs seem to fluctuate annually depending upon the migration conditions (see Figure 23).

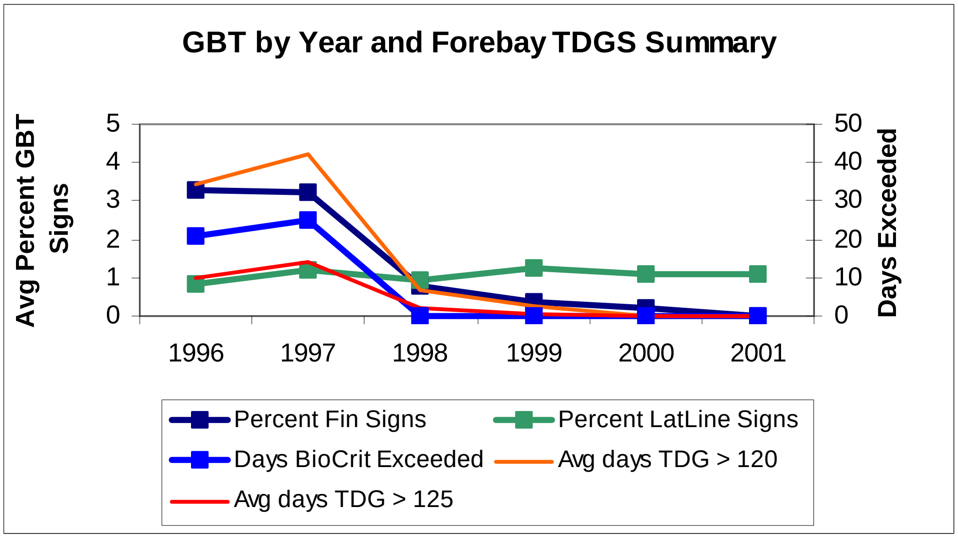

FIGURE 23. The annual percent fin GBT, days exceeding Opinion 15% prevalence or 5% severe fin signs, and percent lateral line GBT compared to high TDGS proportion at forebay monitors. Lateral line signs remain constant through years while fin signs fluctuate with relative TDGS levels.

GBT data from past years'' has been evaluated and given the poor relationship between percent fish with lateral line bubbles and the levels of TDGS in the reach, the amount of time required to examine the lateral line, and the ephemeral nature of lateral line bubbles from a monitoring program standpoint, lateral line bubbles will not longer be monitored. When the waiver standards action criteria of TDGS (5% severe or 15% prevalence of fin signs) were established, it was recognized that the lateral line was not predictive and as such it was excluded as a possible metric for the standard pending further evaluation. Having conducted lateral line exams using 15X magnification for six years it is obvious that the lateral line should not be used as a metric for the TDGS action level. Lateral line bubbles are ephemeral and can disappear relatively quickly by passing out through pores in the lateral line canal. And, since lateral line exams represent at least half the handling time during examination, it seems that the risks associated with extended handling of fish and the lack of utility for the data makes it imprudent to continue them. It appears that fin signs are more appropriate to examine and that the waiver standards appropriately use them to measure the exposure of fish to high TDGS levels during migration.

D. Total Dissolved Gas Saturation

For 2001 the near record low flows and power emergency translated into very low spill volumes and resulted in some of the lowest gas levels observed in recent years. With no spill in the Snake River TDGS levels were basically ambient levels with gas levels highest at the forebay monitors. No TDGS levels approached the waiver limits of 115% in the Snake River. At Lower Columbia River sites gas levels never exceeded the 115%/120% waiver limits. There was spill in the lower river, but again due to low discharge, the spill volumes were low and, consequently, TDGS was low as well.

Lower Snake River Projects

Gas levels ranged at or below 105% TDGS in tailwater monitors at all Lower Snake projects and yet, forebay monitors showed the highest gas levels, with one day each at Little Goose and Lower Granite actually exceeding 110%. These high TDGS levels were likely due to temperature spikes on hot, calm days. Tailwater gas levels were very low compared to other years, and likely this difference from forebay monitors reflected a thermally well mixed tailwater compared to potentially stratified near dam surface waters that are drawn past the forebay sensors under certain operating conditions.

Lower Columbia River Projects

Gas levels at forebay monitors ranged below 115% at all sites this season. McNary and Camas/Washougal showed the highest forebay readings on daily basis with both just over 112%. The Dalles recorded the lowest forebay readings throughout the migration season with gas levels never exceeding 106%. Warrendale, showed the highest tailwater gas levels with TDGS levels reaching 115% on 5/23. Compared to other years, when Opinion spill levels or even uncontrolled spill occurred, these gas levels were very low.

E. Dissolved Gas and Gas Bubble Trauma Summary and Conclusions

In 2001 there very few fish with signs of GBT and this relates quite well with the low TDGS levels found in the river this year. With only one fish displaying fin signs of GBT at Lower Granite, and no other sites in the Lower Snake or Lower Columbia reporting fin signs, it was the lowest level of incidence of GBT since monitoring began in 1995.

III. 2001 SMOLT MONITORING

A. Smolt Monitoring Sites and 2001 Schedules.

Information on the status of the Columbia Basin salmonid smolt migration is collected each year to aid the Fishery Agencies and Tribes in making management decisions beneficial to smolt survival as they migrate from natal streams through the hydro system to the ocean. The Smolt Monitoring Program (SMP) collects data on relative fish abundance at dams, fish migration timing at traps and dams, fish travel time between monitoring sites, and fish survival from traps and dams to downstream monitoring sites. Some of this data are generated for each species from the run-at-large and some of this data is generated from specially marked groups of fish. All of this data is collected for the purpose of in-season management of flows and spills and the post-season evaluation of the effect of that year's management actions on migrating salmonids.

This information is obtained from eleven monitoring sites in the Columbia River basin (sites and dates of operation are presented in Table 19). These monitoring sites include four traps in tributaries above Lower Granite Dam, three dams on the lower Snake River, one dam in the mid-Columbia River reach, and three dams on the lower Columbia River. During periods of monitoring, the daily collection information from each of these sites is transmitted to the FPC, where it is stored and compiled into data summaries for distribution to interested parties in the region. This data is posted daily on the Fish Passage Center's web page at www.fpc.org. Fish were marked for the 2001 outmigration with either PIT tags implanted in the fishes' gut cavity, color elastomer (plastic) tags, or freeze brands. SMP crews look for the elastomer and freeze brands in the samples at the sites and transmitted this data daily to the FPC, while the PIT tags are generally electronically detected without the need for fish handling and sent directly to the Pacific States Marine Fisheries Commission's (PSMFC) PTAGIS data system.

TABLE 19. Smolt monitoring sites and schedules for 2001

Site	Sampling Method	Dates of Operation	Primary Fish Data*
Salmon River trap (km103)	Scoop trap	09:30 3/13 – 07:00 6/8	C, FQ, PIT
Imnaha River trap (km6.8)	Screw trap(s) (1-2 traps)	19:00 2/21 – 06:25 6/21	C, FQ, PIT
Grande Ronde River trap (km 5)	Scoop trap	09:00 3/12 – 09:00 6/1	C, FQ, PIT
Snake River trap (km 225)	Dipper trap	10:30 3/20 – 09:00 6/29	C, FQ, PIT
Snake River dams: Lower Granite Dam (km 173)	Timed subsample from bypass	09:00 3/25 – 07:00 10/31	C, FQ, GBT(1)
Little Goose Dam (km 113)	Timed subsample from bypass	07:00 4/1 – 07:00 10/31	C, FQ, GBT(1)
Lower Monumental Dam (km 67)	Timed subsample from bypass	07:00 4/1 – 07:00 10/31	C, FQ, GBT(1)
Columbia River dams: Rock Island Dam (km 730)	Census of fish in volitional bypass at Powerhouse 2	09:00 3/31 – 09:00 8/31	C, FQ, PIT, GBT(2)
McNary Dam (km 470)	Timed subsample from bypass	12:00 4/1 – 07:00 12/11	C, FQ, GBT(2)
John Day Dam (km 347)	Timed subsample from bypass	16:30 3/29 – 07:00 9/17	C, FQ
Bonneville Dam (km 234)	PH 2: Timed sub-sample from bypass PH 1: trap sample	07:00 3/12 – 07:00 10/31 4/9-7/29 (2-3 d/w)	C, FQ FQ, GBT(2)

* C = fish counts recorded
FQ = fish quality including descaling and injury data obtained
PIT = PIT tagging and release from site
GBT(k) = gas bubble trauma measurements taken “k” days per week

This chapter and associated appendices present data from the 2001 Smolt Monitoring Program on the (1) collection counts at each monitoring site (plus relative magnitude [termed passage index] at dams), (2) migration timing at key sites, (3) travel time between selected sites, and (4) estimates of survival between selected sites. Greater details of the sampling at the traps and dams may be found in the individual reports prepared by the respective monitoring organizations. Washington Department of Fish and Wildlife reports on sampling at Lower Granite, Lower Monumental, Rock Island, and McNary dams. Oregon Department of Fish and Wildlife reports on sampling at Little Goose Dam and the Grande Ronde River trap. Idaho Department of Fish and

Game reports on sampling at the traps on the Salmon and Snake rivers. The Nez Perce Tribe reports on the sampling at the Imnaha River trap. Pacific States Marine Fisheries Commission reports on the sampling at John Day and Bonneville dams.

B. Collection Counts and Relative Abundance.

In the March through October weekly reports prepared by the FPC, a daily passage index is presented for each species and rearing type available in the run-at-large. As long as these daily passage indices remain highly correlated with daily population abundance existing at a given monitoring site, the fishery managers may use the daily passage indices to effectively determine significant shifts in passage at that monitoring site. The actual value of fish guidance efficiency of the screens or effectiveness of spill is not required, only the existence of seasonal stability of these factors is required. The daily passage indices adjust for daily changes in spill proportion under the conservative assumption that the proportion of fish passing through spill will be close to the proportion of water being spilled. For these reasons, when the SMP began in 1984, the use of daily passage indices was chosen over attempts to estimate daily absolute population sizes. The daily passage index is computed by dividing the daily collection by the proportion of water passing through the powerhouse where the sampling takes place (Table 20). Since 1998, sampling at John Day Dam has been with a timed sample from the entire powerhouse bypass system instead of only one gatewell slot as in prior years. Since 2000, the index sampling at Bonneville Dam is with a timed sample at the Powerhouse II bypass system (prior years used timed trap samples from Powerhouse I ‘s bypass system). Sampling at Powerhouse I is now limited to 2-3 days per week for fish condition and gas bubble trauma observations.

At monitoring sites where a sample timer is used to systematically divert a fixed proportion of fish into a sample tank for processing, the resulting sample number is divided by the sample rate to arrive at the estimated collection number. Post-season the daily passage indices are summed for the season at a given site to provide an annual passage index for each species and rearing type available. The passage index is not applicable to the trap sites; therefore, only collection counts are reported at the four traps.

TABLE 20. Formulas to compute passage indices (collection/flow expansion factor) at dams.

Sampling Site	Years	Collection	Flow expansion factor
Rock Island Dam (PH 2)	1985-2001	Catch / 1	PH2/(PH1+PH2+SP)
Lower Granite Dam Little Goose Dam Lower Monumental Dam McNary Dam	1984-2001 1984-2001 1993-2001 1984-2001	Catch / sample rate	PH/(PH+SP)
John Day Dam (bypass) John Day Dam Unit 3	1998-2001 1984-97	Catch / sample rate Catch / 1	PH/(PH+SP) Unit3/(PH+SP)
Bonneville Dam (PH 1)	1986-92 1993-95 1996-99	8 hr catch / sample rate 24 hr catch / sample rate 8 hr catch / sample rate	PH1/(PH1+PH2+SP)
Bonneville Dam (PH 2)	2000-2001	24 hr catch / sample rate	PH2/(PH1+PH2+SP)

Legend: PH=powerhouse flow; PH1=first powerhouse flow; PH2=second powerhouse flow; SP=spill flow; and Unit3=turbine unit 3 flow (note: all flows are 24-hr averages over the sample interval).

1. Snake River Basin

Table 21 presents the cumulative counts of salmonids at the four traps above Lower Granite Dam over the scheduled dates of operation in 2001. These traps operated primarily on a 5 days per week schedule (Sunday afternoon through Friday morning). Sampling on the Imnaha River often involves the use of two traps to increase the number of fish for PIT tagging purposes. Trap counts simply reflect how many fish were handled for timing, fish condition, and PIT tagging purposes. We do not have measures of trap efficiencies for any expansion to run size.

TABLE 21. Sampled numbers of composite wild/hatchery chinook, steelhead, coho, and sockeye at the four traps used in the Smolt Monitoring Program in 2001.

Species	No. of Fish Sampled	Species	No. of Fish Sampled
Salmon River Trap (aboveWhitebird)		**Snake River Trap (at Lewiston)**	
Chinook 1's	12,660	Chinook 1's	527
Steelhead	4,567	Steelhead	5,399
Sockeye	24	Sockeye	None
Chinook 0's	1	Coho	6
		Chinook 0's	31
Imnaha River Trap		**Grande Ronde River Trap**	
Chinook 1's	26,717	Chinook 1's	9,049
Steelhead	34,102	Steelhead	4,357
Chinook 0's	1	Chinook 0's	13

At all monitoring sites, SMP crews report smolt sample counts at the level of clipped and unclipped fish. Because not all hatchery fish are fin clipped in Snake and Columbia River basins, the FPC began in 2000 to report all sample, collection and passage index data for each species at the level of combined hatchery and wild fish in our weekly reports and annual report tables. However, since all hatchery chinook released in tributaries above Lower Granite Dam are supposed to be either fin clipped or unclipped with a coded-wire tag (CWT) implanted to designate a supplementation program fish, we do attempt to collect supplemental data at several sites to help differentiate between hatchery and wild stocks for yearling chinook, and in some cases for steelhead. The supplemental data at the Salmon River trap and Snake River (Lewiston) trap includes counts of unclipped yearling chinook with a CWT and counts of unclipped yearling chinook and steelhead with fin erosion typical of hatchery fish. This additional distinction is necessary in order to PIT tag separately the wild and hatchery yearling chinook and steelhead smolts for travel time and survival estimation. A coded wire detector is also used at Lower Granite and Lower Monumental dams to separate the unclipped hatchery chinook from wild chinook. The FPC makes annual estimates of wild yearling chinook at Lower Granite Dam for IDFG to meet their management need of an estimate of wild yearling chinook migrating past Lower Granite Dam each year (see Table 24). Based on ancillary data collected at the Salmon River trap in 2001, it appears that the incidence of hatchery yearling chinook that are unclipped without a coded wire tag was low this year (the observed 80 yearling chinook with these characteristics would create only a 3.4% over-count of wild fish in 2001). Whereas, similar ancillary data collected on steelhead at the Salmon River trap showed that about half of the unclipped fish collected there had the fin erosion characteristics of hatchery fish. Sockeye are also presented in this report at the combined hatchery and wild level, although hatchery sockeye continue to be 100% fin clipped, because the numbers of hatchery sockeye collected at SMP sites are so small.

The 2001 cumulative number of fish sampled at each Snake River dam, along with expanded annual collection numbers and passage indices are presented in Table 22. The 2001 annual passage indices of yearling chinook, steelhead, coho, and sockeye were each lower than their respective prior 3-year average (1998-2000) passage indices. Reductions in flows with no spill at collector dams in 2001 resulted in fewer smolts remaining in-river below each successive transportation site. The Lower Granite Dam subyearling chinook passage index was similar to last year but much lower at Lower Monumental Dam since subyearling chinook were trucked instead of released on-site from Lyons Ferry Hatchery in 2001 due to the extremely low flows.

TABLE 22. Sample, collection, and passage indices of salmonids at Snake River dams in 2001 and comparison with the past 3-yr average (1998-2000) annual passage indices.

Dam	Species	2001			2000 Passage Index	1998-2000 Average Index
		Sample	Collected	Passage Index		
Lower Granite	Chinook Age 0	57,690	739,851	740,553	747,929	382,929
	Chinook Age 1	24,428	1,958,273	1,958,276	3,290,463	2,931,109
	Coho	2,172	58,255	58,273	166,041	169,905
	Steelhead	65,799	5,580,471	5,580,777	6,782,370	6,311,861
	Sockeye/kokanee	354	4,851	4,851	8,991	34,948
Little Goose	Chinook Age 0	28,238	178,818	178,854	357,060	207,725
	Chinook Age 1	17,537	751,905	751,911	1,876,659	2,566,948
	Coho	2,117	21,878	21,893	54,969	97,320
	Steelhead	26,042	841,490	841,837	1,415,791	2,555,234
	Sockeye/kokanee	325	9,857	9,857	4,893	19,736
Lower Monumental	Chinook Age 0	9,620	53,433	53,516	235,017	132,263
	Chinook Age 1	50,207	553,434	553,436	899,360	1,305,623
	Coho	605	2,676	2,691	30,203	47,944
	Steelhead	38,155	360,382	360,511	1,159,533	1,663,729
	Sockeye/kokanee	77	1,026	1,026	6,605	15,165

The estimates of yearling hatchery chinook population size at Lower Granite Dam provide additional evidence that fewer smolts were arriving at the first dam in 2001 compared to recent past years (Table 23). Population estimates were made using estimates of collection efficiency developed with PIT tagged smolts released from SMP traps. When related to hatchery production above Lower Granite Dam, the 2001 hatchery chinook population arriving at Lower Granite Dam was at least ten percentage points lower than any of the past three years. It is important to make these comparisons with smolt data expanded to population sizes to properly account for differences in annual average collection efficiency among years. A simple ratio of annual passage indices to hatchery releases would have failed to show this reduction in 2001.

TABLE 23. Hatchery yearling chinook population estimates at Lower Granite Dam in 2001 with comparison to prior three years and hatchery production.

Year	Collection efficiency	Collection	Passage index	Population estimate	Hatchery release	% of hatchery release
1998	0.49	1,317,500	1,723,600	2,688,800	4,351,400	61.8%
1999	0.26	1,762,700	2,768,100	6,779,600	11,472,100	59.1%
2000	0.38	2,035,000	2,725,400	5,355,300	7,464,500	71.7%
2001	0.75	1,547,700	1,547,700	2,063,600	4,286,900	48.1%

The estimated population size of yearling wild chinook at Lower Granite Dam was 500,700 smolts in 2001 – approximately half of the 2000 magnitude, a third of the 1999 magnitude, and fairly close to the 1998 magnitude (Table 24). These wild chinook smolt population sizes were divided by 1000 and then compared to the state fishery agencies' annual index of redd counts in the Clearwater, Salmon, Imnaha, and Grande Ronde river basins two years earlier. The resulting ratio was lower for smolts migrating in 2001 than in any of the prior three years. This trend was similar to what was observed with the ratio of estimated hatchery chinook population size to hatchery release.

TABLE 24. Wild yearling chinook population estimates at Lower Granite Dam in 2001 with comparison to prior three years and annual redd counts.

Year	Collection efficiency	Collection	Passage index	Population estimate (popn)	Redd count index[1]	Ratio of smolt popn/1000 to redd index
1998	0.49	287,200	374,500	586,100	893	0.656
1999	0.26	410,800	636,600	1,580,000	2165	0.730
2000	0.38	415,100	565,100	1,092,400	1781	0.613
2001	0.82	410,600	410,600	500,700	912	0.549

[1] redd counts from IDFG for index sites of Salmon and Clearwater River basins and from ODFW for index sites of Grande Ronde and Imnaha River basins.

The estimates of hatchery and wild steelhead population size at Lower Granite Dam provide additional evidence that fewer smolts were arriving at the first dam in 2001 compared to recent past years (Table 25). Population estimates were made using estimates of collection efficiency developed with PIT tagged smolts released from SMP traps. When related to hatchery production above Lower Granite Dam, the 2001 hatchery steelhead population arriving at Lower Granite Dam was at least 17 percentage points lower than any of the past three years. The 2001 wild steelhead population estimate arriving Lower Granite Dam was around one-third lower than that of 1998 to 2000. However, there is no redd count index for wild steelhead for comparison purposes as was the case with wild chinook.

TABLE 25. Steelhead population estimates at Lower Granite Dam in 2001 with comparison to prior three years and hatchery production.

Year	Rear Type[1]	Collection efficiency	Collection	Passage index	Population estimate	Hatchery release	% of hatchery release
1998	H	0.59	4,527,500	6,163,500	7,673,700	8,956,100	85.7%
1998	W	0.59	558,000	755,000	945,800		
1999	H	0.37	3,032,100	4,732,400	8,194,900	9,573,500	85.6%
1999	W	0.31	323,100	502,300	1,042,300		
2000	90% H	0.63	4,535,700	6,104,100	7,199,500	9,568,500	75.2%
2000	10% W	0.53	504,000	678,200	950,900		
2001	90% H	0.91	5,022,400	5,022,700	5,519,100	9,442,600	58.4%
2001	10% W	0.87	558,000	558,100	641,400		

[1] Since steelhead have not been distinguishable by clip status as hatchery or wild since 2000, the relative average split observed from 1989 to 1999 of 10% wild and 90% hatchery was applied to the total steelhead collections and passage indices in 2000 and 2001.

2. Columbia River Basin

The 2001 cumulative number of fish sampled at each dam, along with expanded annual collection and passage indices, are presented in Table 26 for Columbia River dams. The 2001 Rock Island Dam annual passage indices of yearling chinook, steelhead, and sockeye were each lower than their respective prior 3-year average (1998-2000) passage indices, while that of coho was virtually unchanged. Although the 2001 Rock Island Dam passage index was lower by almost 80% for both yearling chinook and sockeye from the 3-year average, the 2001 sockeye passage indices was actually higher than observed in 2000. The 2001 McNary and John Day Dam annual passage indices of coho, steelhead, and sockeye were each much lower than their respective prior 3-year average (1998-2000) passage indices, while that of yearling chinook was only slightly lower. Sockeye passage indices in 2001 at McNary, John Day, and Bonneville dams were all higher than observed in 2000. Subyearling chinook passage indices remained near or above levels of the past three years at each Columbia River dam.

TABLE 26. Sample, collection, and passage indices of salmonids at Columbia River dams in 2001 and comparison with the past 3-yr average (1998-2000) annual passage indices.

Dam	Species	2001 Sample	2001 Collected	2001 Passage Index	2000 Passage Index	1998-2000 Average Index
Rock Island	Chinook Age 0	21,287	21,287	22,639	13,687	19,744
	Chinook Age 1	4,893	4,893	6,572	25,292	30,191
	Coho	32,710	32,710	45,425	49,548	45,848
	Steelhead	12,976	12,976	17,852	23,590	28,273
	Sockeye	2,197	2,197	3,022	2,428	14,087
McNary	Chinook Age 0	206,502	10,727,489	10,774,712	10,661,118	9,858,790
	Chinook Age 1	35,330	2,226,183	2,299,417	1,998,412	2,473,747
	Coho	2,031	141,382	147,051	260,186	261,183
	Steelhead	15,350	553,432	563,078	616,339	732,343
	Sockeye	3,132	269,893	285,379	140,394	849,925
John Day	Chinook Age 0	40,215	2,840,619	2,849,770	1,681,001	2,599,219
	Chinook Age 1	41,659	948,154	1,005,994	827,712	1,387,688
	Coho	3,037	79,576	81,586	263,801	459,909
	Steelhead	10,961	187,901	191,089	522,227	945,432
	Sockeye	3,023	96,207	103,905	60,021	385,913
Bonneville Power House #2	Chinook Age 0 Total	57,366	2,348,968	2,940,644	3,814,968	N/A
	Chinook Age 0 “upriver brights”	50,915[a]	1,910,348[a]	2,451,747[a]	772,819[b]	N/A
	Chinook Age 1	21,304	1,320,763	1,687,847	2,539,352	N/A
	Coho	24,093	1,496,057	2,164,019	1,977,605	N/A
	Steelhead	5,696	366,174	489,400	657,552	N/A
	Sockeye	1,161	74,953	106,965	65,490	N/A

[a] Upper brights annual values are summed commencing May 1 in 2001, since only two tule chinook releases from Spring Creek Hatchery (March 8 and April 15).

[b] Upper brights annual passage index is summed commencing June 1 in 2000, since three tule chinook releases from Spring Creek Hatchery (March 9, April 20, and May 18).

C. Migration Timing.

The distribution of the daily passage indices at the dams provides a measure of migration timing at a given site. From the passage distributions at Lower Granite, Rock Island, McNary, and Bonneville dams, the dates of passage at the key cumulative percentiles of 10%, 50%, and 90% are reported for each species in Table 27. This passage timing data is also plotted for the run-at-large in Appendix D.

1. Snake River Basin

In the Snake River at Lower Granite Dam, the 2001 dates of 10% passage commenced in the later half of April for yearling chinook and steelhead, after mid-May for coho, and near mid-June for subyearling chinook. These dates were around a week later than last year for the spring-time migrants and a few days earlier than last year for the subyearling chinook. The dates of median passage were about the same between this year and last year for all smolts except the coho. In 2001, coho had a middle 80% passage period that extended 39 days longer than it did in 2000. The dates of 90% passage of yearling chinook and steelhead were only three days later than last year, and that of subyearling chinook was 10 days earlier. Because of the low numbers and sporadic passage distribution of sockeye in both 2000 and 2001, it is very difficult to define the period of middle 80% passage in those years; however, the median date of passage differed by only one day between these years.

TABLE 27. Migration timing of salmonids at Lower Granite, Rock Island, McNary, and John Day dams in 2001 compared to 2000.

(see footnotes top of next page)

Dam	Species	2001			2000		
		10%	50%	90%	10%	50%	90%
Lower Granite	Chinook Age 0	6/11	7/4	8/10	6/14	7/3	8/20
	Chinook Age 1	4/26	5/5	5/18	4/21	5/4	5/15
	Coho	5/18	6/4	7/13	5/12	5/25	6/4
	Steelhead	4/29	5/10	5/27	4/19	5/8	5/24
	Sockeye and kokanee	4/21–5/13 [b]	5/23	6/16	4/15	5/24	6/28 – 8/27 [a]
Rock Island	Chinook Age 0	6/25	7/15	7/29	4/19	7/15	8/10
	Chinook Age 1	4/20	5/6	5/30	5/3	5/14	5/31
	Coho	5/19	5/24	6/8	5/20	5/27	6/7
	Steelhead	5/12	5/26	6/17	5/5	5/18	5/28
	Sockeye	5/22	5/25	6/4	4/21	5/13	7/13
McNary	Chinook Age 0	6/20	7/2	7/28	6/21	6/30	7/30
	Chinook Age 1	5/11	5/26	6/7	4/28	5/15	6/2
	Coho	5/24	6/3	6/20	5/27	6/7	6/22
	Steelhead	4/27	5/23	6/9	4/12	5/10	6/6
	Sockeye	5/27	6/1	6/9	5/9	5/30	9/9
Bonneville PH 2	Chinook Age 0 "upriver brights"	5/30[d]	7/6[d]	8/14[d]	6/6[c]	6/22[c]	7/19[c]
	Chinook Age 1	4/26	5/11	6/6	4/23	5/17	6/1
	Coho	5/15	5/24	6/3	5/6	5/22	6/3
	Steelhead	5/4	5/19	6/10	4/27	5/17	6/2
	Sockeye	6/3	6/10	6/25	5/5	5/25	6/7

[a] Low numbers and sporadic collections result in cumulative passage index taking two months to go from 89% to 91%, so the 89% to 91% date range is presented rather than a single 90% passage date.

[b] Low numbers result in cumulative passage index taking over three weeks to collect next fish after 10% point reach on April 21, so "true" date of 10% could occur later during the extended range shown.

[c] Upper brights annual values are summed commencing May 1 in 2001, since only two tule chinook releases from Spring Creek Hatchery (March 8 and April 15).

[d] Upper brights annual passage index is summed commencing June 1 in 2000, since three tule chinook releases from Spring Creek Hatchery (March 9, April 20, and May 18).

2. Mid-Columbia River Basin

In the Mid-Columbia River at Rock Island Dam, the 2001 dates of 10% passage commenced in the later half of April for yearling chinook, in mid-to-late May for coho, steelhead, and sockeye, and in the later half of June for subyearling chinook. The 10% date for yearling chinook was almost two weeks earlier than last year, but only about a week earlier than in years prior to 2000. The 90% passage dates for yearling chinook were nearly the same between 2000 and 2001. The middle 80% passage period for coho was nearly the same between 2000 and 2001. Steelhead's middle 80% passage period commenced about a week later in 2001 and extended 20 days later into June than it did in 2000. The most dramatic change in 2001 occurred for sockeye. The 10% passage date in 2001 was one month later than in 2000, which indicates that the contribution of Wenatchee stock of sockeye to the 2001 sockeye run was negligible. Wenatchee sockeye normally begin migrating in the latter half of April, while the Osoyoos stock of sockeye begin migrating around mid-May. The 90% passage date for sockeye occurred one month earlier than in 2000, making the middle 80% passage period for sockeye in 2001 of only 12 days duration. The date of 10% passage of subyearling chinook occurred during the later half of June, which was later than in most years were the date falls during the first half of June (the extremely early 10% passage date in 2000 was the result of a larger than usual collection of subyearling chinook fry in April that year). The date of median passage of subyearling chinook was July 15 in both 2001 and 2000, while the date of 90% passage was at the end of July in 2001, half a month earlier than in 2000, but similar to other past years.

3. Lower Columbia River Basin

The 2001 passage timing of smolts at McNary Dam primarily reflected the movement of Mid-Columbia River stocks into the lower Columbia River. This is because most springtime and summertime migrating smolts from the Snake River basin were removed from the hydro system and transported in 2001 (see Appendix I). The 2001 date of 10% passage of yearling chinook, steelhead, and sockeye was about two weeks later than in 2000. This later start of the springtime smolt movement past McNary Dam in 2001 was due in part to low flows this year slowing the movement of smolts originating above Rock Island Dam to McNary Dam (see following travel time section). The date of 10% passage of coho was similar to 2000 and appears to reflect the earlier migration timing of coho from the Yakima River, compared to the Wenatchee and Methow rivers. The dates of 90% passage at McNary Dam of yearling chinook, steelhead, and coho was similar to that observed in 2000. The date of 90% passage of sockeye in 2001 was much earlier than in 2000, but similar to that of prior years. The middle 80% passage period of subyearling chinook in 2001 was nearly identical to that of 2000, and not unlike that of prior years, reflecting the fact that most subyearling chinook passing McNary Dam originate in McNary pool from the Hanford reach for wild fall chinook and from Priest Rapids and Ringold hatcheries for hatchery fall chinook.

In the lower Columbia River at Bonneville Dam, the 2001 dates of 10% passage commenced in the later half of April for yearling chinook, in early May for steelhead, around mid-May for coho, and in early June for sockeye. These 2001 dates are close to that of 2000 for yearling chinook, a week later for steelhead and coho, and a month later for sockeye. The 2001 dates of 90% passage differed mostly for steelhead and sockeye from that of 2000. With the exception of sockeye, the passage dates at Bonneville Dam are highly influenced by smolts originating in the lower Columbia River. This was more pronounced in 2001 due to alternating days of transportation at McNary Dam during the springtime, which reduced the numbers of Mid-Columbia River origin springtime migrants remaining in-river in the lower Columbia River. The middle 80% passage period for subyearling chinook in 2001 was much longer in duration than that of 2000, and the cumulative passage index of subyearling chinook “brights” in 2001 was about triple that of 2000.

The determination of migration timing through the lower Columbia River of yearling chinook and steelhead smolts that originated in the four major basins above John Day Dam was important in 2001 because of the limited amount of spill for fish passage provided at John Day, The Dalles, and Bonneville dams. A set of John Day Dam yearling chinook and steelhead smolt migration timing plots was developed using PIT tagged fish released in the Umatilla River, John Day River, Snake River basin and Mid-Columbia River basins. Each cumulative proportion curve for a basin is a simple summation of PIT tagged smolts from different releases within the respective basin. PIT tagged smolts from large releases at dams for special studies were not included since they did not reflect the timing of the run-at-large. Migration timing plots are available for migration years 1998 to 2001 for yearling chinook and steelhead from the Umatilla, Snake, and Mid-Columbia River basins. For the John Day River basin, yearling chinook migration timing data was available for 2000 and 2001, while the steelhead migration timing data was only available for 2001.

The John Day Dam passage timing of PIT tagged yearling chinook showed that yearling chinook and steelhead originating in both the John Day and Umatilla River basins pass earlier than those that originate above McNary Dam in the Snake and Mid-Columbia River basins (Appendix E Figure 24 to Figure 31). Since springtime spill for fish passage in 2001 was provided only between May 25 and June 15 at McNary and John Day dams and between May 16 and June 15 at The Dalles and Bonneville dams, few of the yearling chinook and steelhead from the Umatilla and John Day River basins benefited from this late season spill in 2001 (see memorandum on spill in Appendix A).

D. Travel Time.

The PIT tag provides a unique alphanumeric code for individual fish that allows determination of date and time of passage of these fish at dams with PIT tag detection equipment in place. From these data, travel times of individual fish within reaches of interest may be computed. Travel time is estimated from release to first detection site, and between series of dams, by subtracting the upstream detection date and time from the downstream detection date and time for PIT tagged fish. From the distribution of travel times for each group of PIT tagged fish, minimum, maximum, and median travel time with associated 95% confidence interval are computed. Associated with the travel time data are flow and river temperature averages. These environmental parameters are computed at a key dam within the reach of interest as the average across a series of days equal to the number of days estimated as the median travel time. This series of days begin with the date of release for travel times estimated from release to first monitoring site (*e.g.*, Snake River basin sites to Lower Granite Dam or Mid-Columbia River basin sites to McNary Dam), and they begin with the date of re-release at the upstream dam for travel times estimated between two dams (*e.g.*, Lower Granite Dam to McNary Dam, Rock Island to McNary Dam, and

McNary Dam to Bonneville Dam). The detailed travel time data for groups of PIT tagged fish released from the four traps, selected hatcheries, and Rock Island Dam or re-released from Lower Granite and McNary dams are presented in Appendix F.

1. Snake River Basin

Hatchery Site to Lower Granite Dam Reach

Estimated median travel times of yearling chinook from Dworshak, McCall, Imnaha, and Rapid River hatcheries to Lower Granite Dam have been fairly long in all four years, 1998 to 2001, averaging around a month or more (Table 28). Estimated travel time of steelhead from Dworshak Hatchery was nearly a week, longer than that of most recent years, but well under the long travel time of their chinook counterparts.

TABLE 28. Median travel time from release to Lower Granite Dam for Snake River basin hatchery yearling chinook and steelhead in 2001 compared to the past three years.

Hatchery	Species	Median travel time release site to Lower Granite Dam			
		2001	2000	1999	1998
Dworshak H	Chinook	30.4	27.3	27.7	28.1
Imnaha AP	Chinook	29.1[a]	29.3[a]	23.7[a]	26.2
McCall H	Chinook	48.5	34.1	39.9	36.5
Rapid River H	Chinook	32.3[c]	29.0[c]	37.1[b]	19.5[b]
Dworshak H	Steelhead	6.8	3.5	6.2	4.7

[a] Midpoint of volitional release period used in calculation.

[b] Projected median date of volitional release period used in calculation.

[c] Monitored median date of volitional release period used in calculation.

For migration years 2000 and 2001, the addition of PIT tag detection capabilities on the pond exit at Rapid River Hatchery has allowed more precise determination of the date when 50% of the hatchery production has emigrated during the hatchery's typical 30 to 40-day volitional release period. In both 2000 and 2001, the beginning of the volitional release period was March 15. The date of median release was April 4 in 2000 and March 29 in 2001 (Figure 24). Prior years date of median passage were based on the hatchery manager's prediction.

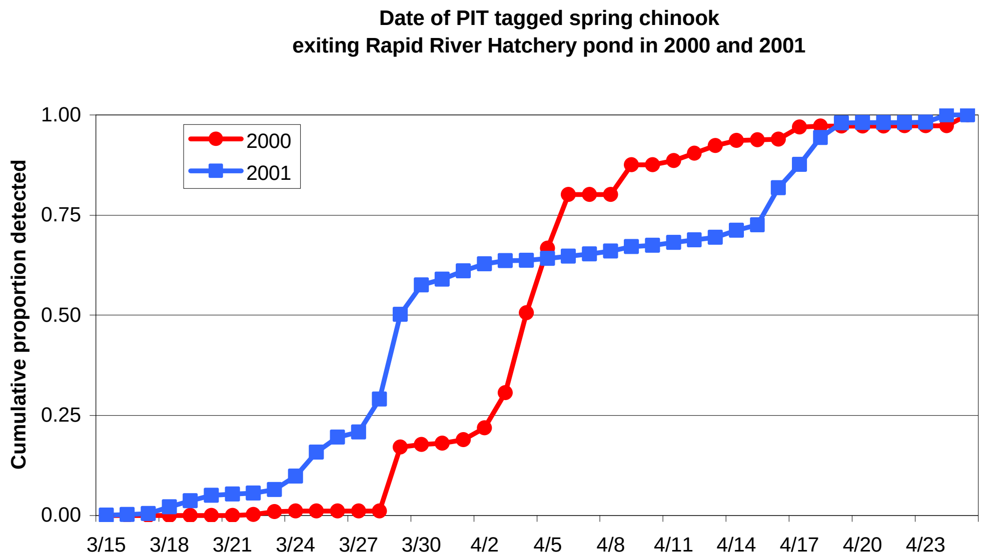

FIGURE 24. Exit timing plot for PIT tagged yearling chinook at Rapid River Hatchery in 2000 and 2001.

Traps to Lower Granite Dam

Trap releases of PIT tagged yearling chinook and steelhead made between April 10 and May 10 are selected for each of the four recent years, 1998 to 2001, to illustrate effects of flow on travel time during a period beginning late enough so that the smolts appear to be actively migrating and ending prior to any late spring peak flows. Travel times of daily released PIT tagged smolts within this period for a given year are fairly stable across days for a given species, thus facilitating the use of a single average for each year. A 31-day (April 10-May 10, inclusive) average travel time is computed along with the average flow over this 31-day period for each year from the daily releases of PIT tagged yearling chinook and steelhead from the traps on the traps on the lower Salmon, Grande Ronde, and Imnaha rivers, and mainstem Snake River at Lewiston. The results show that migration year 2001, which had the lowest flows, had corresponding longer travel times for steelhead, but not for yearling chinook (Table 29). Yearling chinook travel times to the first dam tend to be long in all years, regardless of flows encountered, indicating that flow is likely not the primary factor determining yearling chinook migration rate to Lower Granite Dam.

TABLE 29. Average travel time and flow for yearling chinook and steelhead released from traps on the Salmon, Imnaha, Grande Ronde, and Snake rivers to Lower Granite Dam in migration years 1999 to 2001.

Year	Average[1] Flow (kcfs)	Average Travel time (days)[2]							
		Salmon R trap		Imnaha R trap		Grande Ronde R trap		Snake R Trap	
Yrlg. Chinook		H	W	H	W	H	W	H	W
1999	100.4	20.2	9.4	24.3	12.1	23.7	7.2	6.3	4.9
2000	88.5	15.9	11.4	20.7	10.6	11.4	6.8	6.7	5.3
2001	55.4	14.4	11.6	12.4	11.1	13.3	10.4	7.8	5.5
Steelhead		H	W	H	W	H	W	H	W
1999	100.4	6.0	4.7	15.2	4.6	3.0	2.9	1.9	2.0
2000	88.5	4.7	N/A	9.6	4.7	3.5	3.0	2.1	2.1
2001	55.4	9.1	6.5	10.1	8.0	6.5	4.2	5.2	3.9

[1] Flow averaged from April 20 to May 20 at Lower Granite Dam.

[2] Average (weighted by released number) of median travel time estimates from daily releases between April 10 and May 10.

Lower Granite Dam to McNary Dam Index Reach

Yearling Chinook Travel Time

Weighted weekly average travel time estimates were generated for yearling chinook in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix F. A weekly averaging of the daily median travel times was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Flow was averaged at Ice Harbor Dam over a period of days equal to the travel time estimate and beginning at the midpoint of the weekly block. In 2001, as in the prior three years, the general trend of decreasing average travel time over weeks was observed (Table 30). Historically, when early and late portions of a migration season have similar flows, smolts in the later period had shorter reach travel times. Temporal increases in yearling chinook and steelhead smoltification over time was discussed in Berggren and Filardo (1993) as a possible link.

The magnitude of the average travel time for each weekly interval in 2001 was much higher than in the previous three years, with correspondingly much lower flows. A weighting of each weekly average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for yearling chinook in the Snake River index reach was between approximately 10 and 12 days in each of the prior three years, and was at least 50% higher in 2001 at an average of 17.8 days (Figure 25). Flows in 2001 encountered by the yearling chinook in this index reach averaged only 65 Kcfs in 2001 compared to seasonal averages over 90 Kcfs in the earlier three years.

TABLE 30. Weighted average travel time1 for weekly blocks for yearling chinook from Lower Granite Dam to McNary Dam, 1998 to 2001.

		1998		1999		2000		2001	
Block	Date range	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1	4/2 – 4/9	23.0	71.9	16.8	91.9			29.7	41.4
2	4/10 - 4/17	15.9	74.7	12.7	107.3	12.5	109.2	24.9	44.6
3	4/18 - 4/24	12.4	89.5	11.5	116.8	11.7	104.2	21.0	50.6
4	4/25 - 5/1	12.3	114.7	10.6	107.2	10.4	98.7	20.2	61.9
5	5/2 – 5/8	10.8	128.9	10.2	96.1	10.2	86.8	19.5	66.0
6	5/9 – 5/15	10.6	129.7	9.8	89.5	11.1	76.9	15.4	73.6
7	5/16 - 5/22	9.2	160.8	7.8	123.0	8.5	90.2	12.1	69.2
8	5/23 - 5/30	7.0	191.7	6.8	174.0	7.5	90.3	17.0	52.9

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix F Table F-21) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

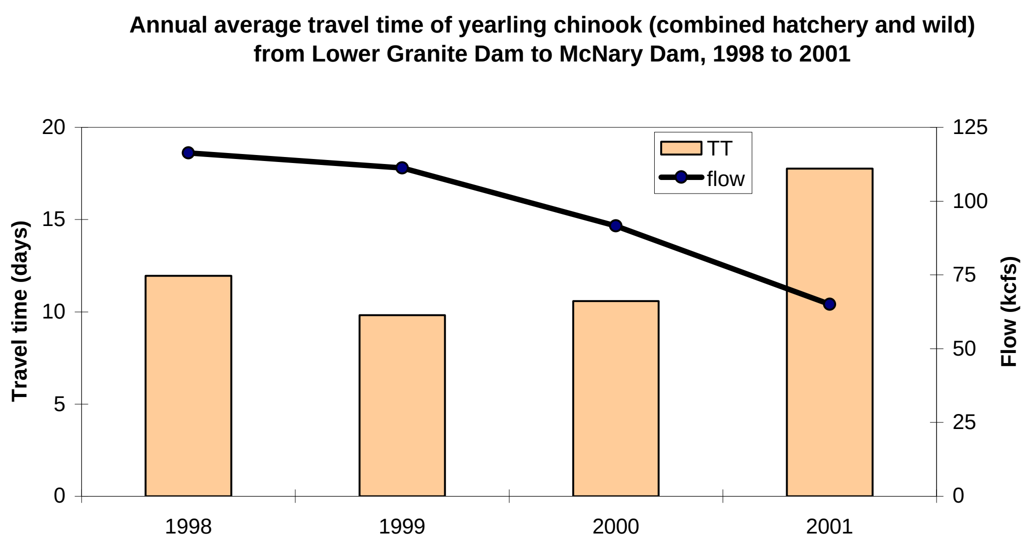

FIGURE 25. Annual average travel time of yearling chinook from Lower Granite Dam to McNary Dam in 2001 compared to 1998 – 2000.

The weekly average travel times of yearling chinook were regressed against the average flow. The four years and eight temporal blocks were pooled to provide a single inverse exponential relation (natural logarithm of average travel time versus reciprocal of flow). The regression of average travel time and flow for the aggregate of four years was significant for yearling chinook ($P<0.01$, $R^2 = 0.84$, $\ln TT = 1.714 + 68.900/FLOW$, Figure 26). The addition of 2001 data provided the lowest flows of the four years and helped improve the predictive capability of the flow/travel time model for yearling chinook. Also plotted is the prediction curve generated in the past for this Snake River reach with PIT tag data yearling chinook from 1991 to 1997 ($P<0.01$, $R^2 = 0.35$, $\ln TT = 2.087 + 35.662/FLOW$). Note how the two curves follow the same trend, but with a higher slope coefficient present in the regression curve of the more recent (1998 to 2001) data.

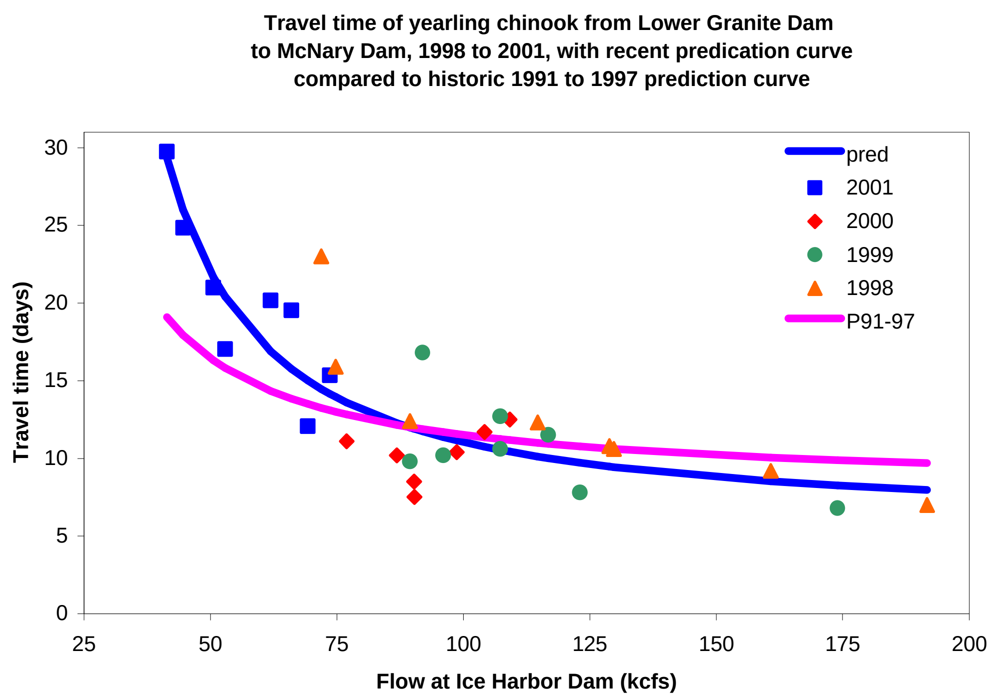

FIGURE 26. Travel time/flow relation for yearling chinook from Lower Granite Dam to McNary Dam with comparison of recent prediction curve (1998-2001 data) to the historic curve (1991-1997 data) used in the PATH analyses.

Steelhead Travel Time

Likewise weighted weekly average travel time estimates were generated for steelhead in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix F. The weekly estimates of survival of steelhead decreased over time in 1998 and 1999, but not in 2000 and 2001. Instead, the weekly average survival of steelhead appears to follow the average flow, being lower when flows are higher, regardless of time of season (Table 31). Because flows remained low throughout 2001, the weekly average travel times for steelhead remained high.

A weighting of each weekly average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for steelhead in the Snake River index reach was between 9.5 and 11 days in the prior three years, and was over 60% longer in 2001 at an average of 17.6 days (Figure 27). Flows in 2001 encountered by the steelhead in this index reach averaged only 64 Kcfs in 2001 compared to seasonal averages over 90 Kcfs in the earlier three years.

TABLE 31. Weighted average travel time1 for weekly blocks for steelhead from Lower Granite Dam to McNary Dam, 1998 to 2001.

		1998		1999		2000		2001	
Block	**Date range**	**Travel time**	**Flow**	**Travel Time**	**Flow**	**Travel time**	**Flow**	**Travel time**	**Flow**
1	4/2 – 4/9	15.1	64.7						
2	4/10 - 4/17	15.6	74.7			9.2	108.9		
3	4/18 - 4/24	11.3	88.0	14.0	116.0	8.6	107.5	25.6	54.7
4	4/25 - 5/1	10.4	110.4	10.1	107.8	9.4	99.1	19.1	60.4
5	5/2 - 5/8	10.1	128.9	10.6	95.2	10.7	85.6	17.5	66.1
6	5/9 - 5/15	9.1	128.8	11.8	94.0	14.6	82.4	14.1	73.5
7	5/16 - 5/22	7.9	154.3	7.6	123.0	11.5	90.3	16.2	64.7
8	5/23 - 5/30	5.8	196.3	6.1	174.4	10.9	86.0	21.8	50.1

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix F Table F-22) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

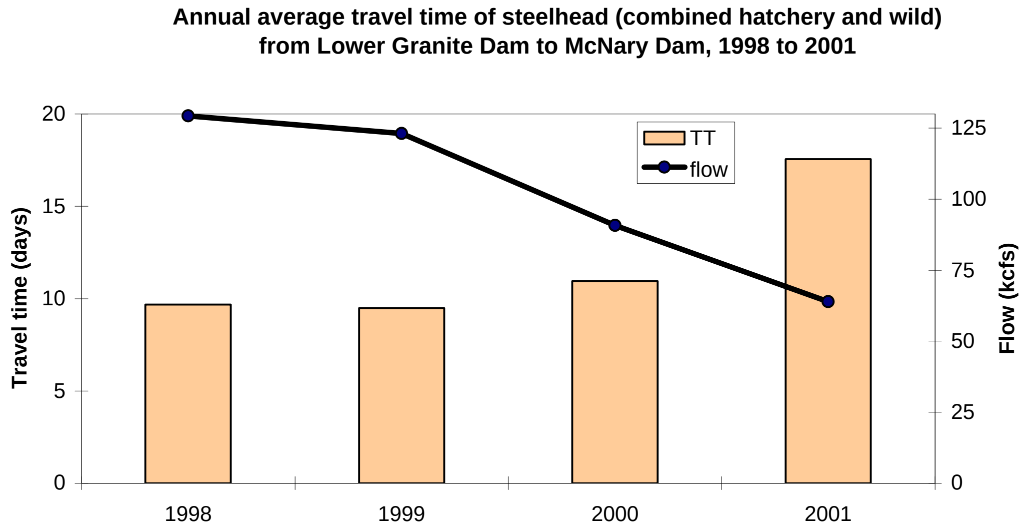

FIGURE 27. Annual average travel time of steelhead from Lower Granite Dam to McNary Dam in 2001 compared to 1998 – 2000.

The weekly average travel times of steelhead were regressed against the average flow. The four years and eight temporal blocks were pooled to provide a single inverse exponential relation (natural logarithm of average travel time versus reciprocal of flow). The regression of average travel time and flow for the aggregate of four years was significant for steelhead ($P<0.01$, $R^2 = 0.93$, $\ln TT = 1.449 + 89.414/FLOW$, Figure 28). The addition of 2001 data provided the lowest flows of the four years and helped improve the predictive capability of the flow/travel time model for steelhead. The steelhead travel time data shows a closer fit around the regression curve than was observed for yearling chinook. The travel time of steelhead appears to be more greatly affected by the prevailing flows than that of yearling chinook.

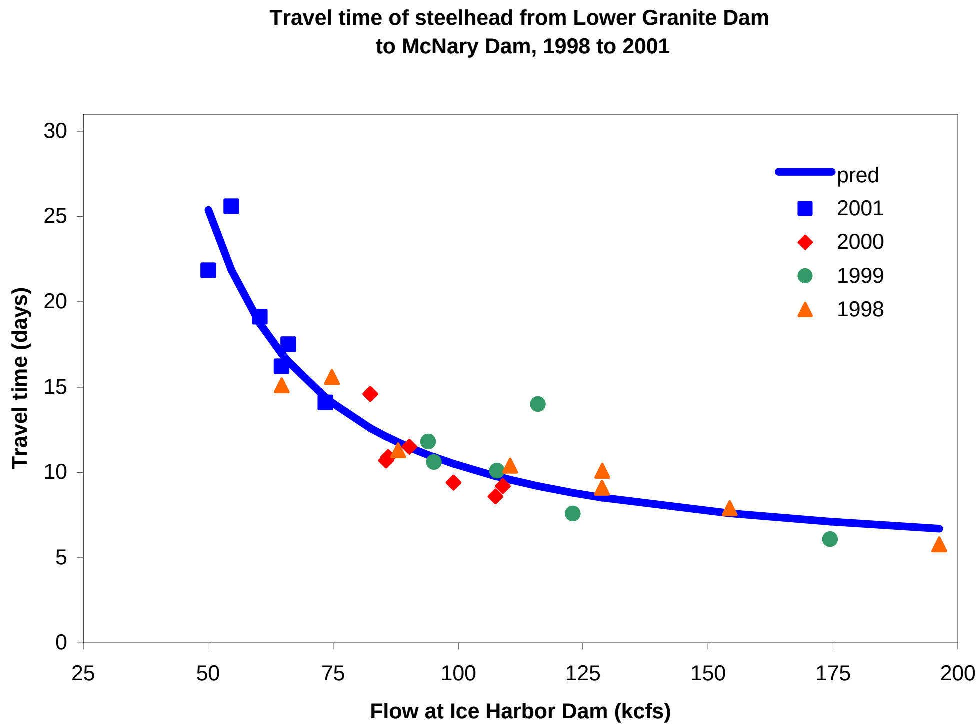

FIGURE 28. Travel time/flow relation for steelhead from Lower Granite Dam to McNary Dam.

Subyearling Chinook Travel Time

Weighted estimates of travel time were generated for subyearling chinook within Lower Granite Dam passage periods of 17 to 20 days in duration. These temporal blocks were wider than the weekly blocks used with yearling chinook and steelhead because of fewer PIT tagged subyearling chinook available for analysis. PIT tagged Lyons Ferry Hatchery subyearling chinook release from the three acclimation ponds (Captain John Rapids, Pittsburg Landing, and Big Canyon acclimation ponds) and in the weekly direct stream releases near those acclimation ponds were used in the analysis. The average travel time estimates for each temporal block were generated for subyearling chinook in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix F. A multi-week averaging of the daily median travel time estimates and their associated Ice Harbor Dam flow data was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. In 2001, as in the prior six years, the general trend of decreasing average travel time over time was observed (Table 32).

The magnitude of the average travel in each period for 2001 was much higher than in the previous six years, with correspondingly much lower flows. A weighting of each multi-week average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for subyearling chinook in the Snake River index reach was between approximately 12 and 21 days in each of the prior six years, and was at least 50% longer in 2001 at an average of 32.3 days (Figure 29). Flows in 2001 encountered by the subyearling chinook in this index reach averaged only 27.6 Kcfs in 2001 compared to seasonal averages well over 40 Kcfs in the earlier six years.

TABLE 32. Weighted average travel time1 for subyearling chinook from Lower Granite Dam to McNary Dam within temporal blocks across seven years, 1995 to 2001, and corresponding weighted average flow.

Year	Date of passage at Lower Granite Dam							
	6/5-6/24		6/25-7/11		7/12-7/31		8/1-8/20	
	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1995			19.7	63.9	14.1	46.3	14.2	38.1
1996			22.7	49.4	15.2	39.9	14.0	38.3
1997	28.5	98.7	25.4	74.2	17.6	64.1	12.8	54.4
1998	20.1	87.8	12.3	66.9	10.8	58.6	10.9	40.5
1999	21.3	105.1	23.1	63.9	15.6	51.2	13.5	42.9
2000	15.6	52.1	20.3	43.6	16.5	37.7	15.8	30.3
2001	39.5	29.2	27.9	27.4	35.5	26.2	18.1	23.7

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix F Table F-23) by number of fish used to generate each daily median travel time estimate.

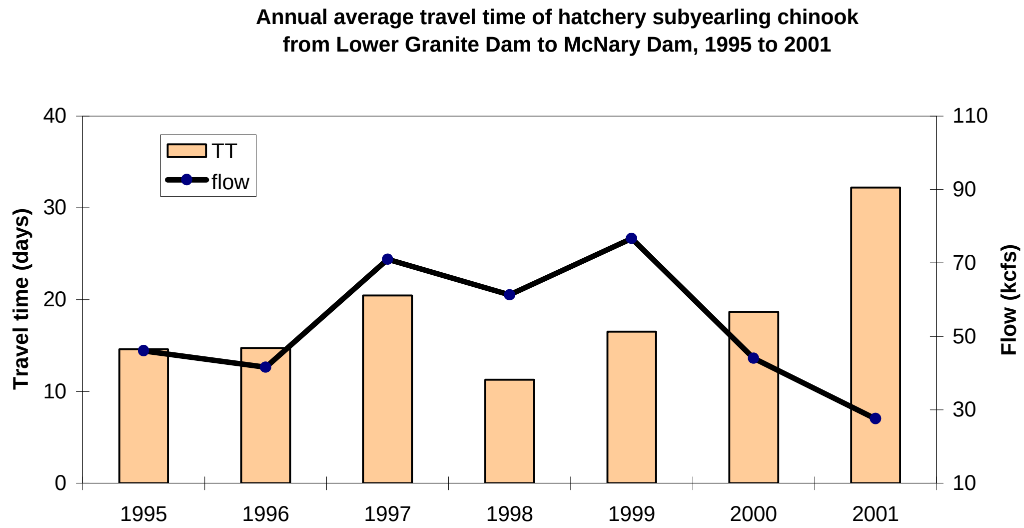

FIGURE 29. Annual average travel time of subyearling chinook from Lower Granite Dam to McNary Dam in 2001 compared to 1995 – 2000.

2. Mid-Columbia River Basin

Hatchery Site to McNary Dam Reach

Travel time of yearling and subyearling chinook from hatcheries in the Mid-Columbia River basin to McNary Dam is presented in Table 33. Median travel time to McNary Dam was 37 days in 2001 for both yearling spring chinook from Leavenworth and Winthrop hatcheries, which was relatively close to what was observed in 2000 but over ten days longer than observed in 1998 and 1999. Subyearling summer chinook from Wells Hatchery had a median travel time of approximately 38 days in 2001, similar to last year, but a week longer than observed in 1998 and 1999. The median travel time of subyearling chinook released from Priest Rapids and Ringold hatcheries have ranged within a one to two-week period (most often around 12 days) across the four years.

TABLE 33. Median travel time for Mid-Columbia River hatchery chinook from hatchery site to McNary Dam in 2001 compared to 1998 to 2000.

Hatchery		Migration Year							
		2001		2000		1999		1998	
	Age	TT	Flow	TT	Flow	TT	Flow	TT	Flow
Leavenworth	1	37.0	64	36.1	185	27.8	171	21.7	142
Winthrop	1	36.9	64	30.2	182	26.4	163	25.7	125
Wells	0	37.8	71	35.3	133	30.6	193	30.8	149
Priest Rapids[1]	0	13.7	95	12.3	137	11.7	189	7.4	147
Ringold	0	11.5	94	9.8	140	12.0	183	12.1	150

[1] Priest Rapids Hatchery's median travel time and flow is computed as average of three releases separated 3-5 days apart starting mid-June (individual release data shown in appendix of each annual report).

Rock Island Dam to McNary Dam Index Reach

Weighted estimates of travel time to McNary Dam were generated for yearling chinook and steelhead for two periods of PIT tag smolt releases from Rock Island Dam (an early month long period through May 15 and a later three-week period after May 15). This multi-week averaging of the daily median travel times and their associated Priest Rapids Dam flow data was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Yearling chinook and steelhead had longer travel times between Rock Island Dam and McNary Dam for both temporal periods in 2001 than they did in the prior two years (Table 34). A weighting of these two passage period's average travel time by their associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for yearling chinook in the Mid-Columbia River index reach was between 12 and 14 days in the 1999 to 2000, and was at least 60% longer in 2001 at an average of 22.3 days (Figure 30). The steelhead annual average travel time estimates was just under 7 days in 1999 and 2000, and was approximately 150% longer in 2001 at an average of 17.4 days (Figure 31). Mid-Columbia River springtime flows indexed at Priest Rapids Dam averaged below 85 Kcfs in 2001, compared to seasonal averages well above 140 Kcfs in the other two years

TABLE 34. Weighted average travel time[1] for yearling chinook, steelhead, and sockeye (combined hatchery and wild) from Rock Island Dam to McNary Dam within temporal blocks across three years, 1999 to 2001, and corresponding weighted average flow.

Species[2]	Year	Date of release at Rock Island Dam			
		4/16 – 5/15		5/16 – 6/6	
		Travel time	Flow	Travel time	Flow
Yearling Chinook	1999	13.5	173.6	8.6	165.1
	2000	15.2	176.4	12.1	140.4
	2001	25.3	62.1	16.7	84.3
Steelhead	1999	6.8	172.1	6.7	157.6
	2000	6.0	180.5	7.5	151.2
	2001	19.8	63.1	16.8	84.4
Sockeye	1999	7.2	176.2	5.5	155.2
	2000	14.1	183.6	10.6	149.5
	2001	24.8	61.6	7.4	77.1

[1] For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix F Tables F-17, F-19, and F-20) by number of fish used to generate each daily median travel time estimate.

[2] Mixture of hatchery and wild fish

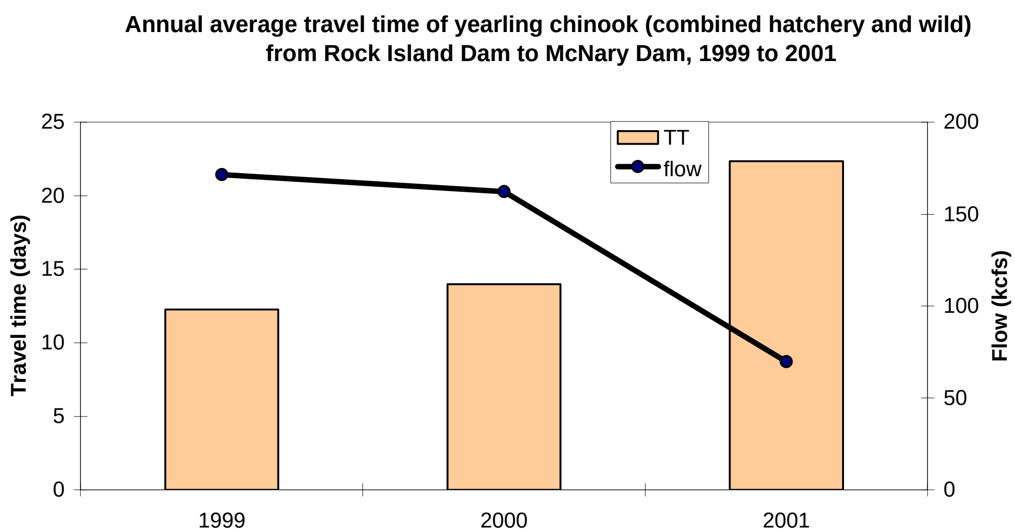

FIGURE 30. Annual average travel time of yearling chinook from Rock Island Dam to McNary Dam in 2001 compared to 1999 – 2000.

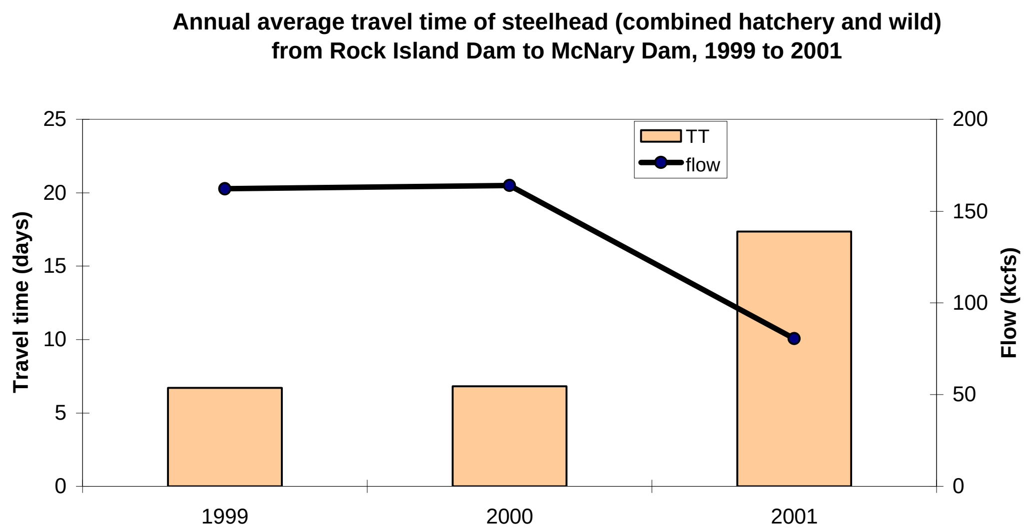

FIGURE 31. Annual average travel time of steelhead from Rock Island Dam to McNary Dam in 2001 compared to 1999 – 2000.

The sockeye passing Rock Island Dam did not have the consistent pattern of longer travel times in 2001 compared to the prior two years as was observed for yearling chinook and steelhead. Sockeye passing Rock Island Dam through May 15 had a much longer travel time in 2001 compared to the prior two years. Whereas, those sockeye passing Rock Island dam after May 15 had an average travel time of 7.4 days which was intermediate between the levels of the past two years. The stock of sockeye passing Rock Island Dam after May 15 is predominately of Lake Osoyoos origin, while the stock of sockeye typically passing in the latter half of April is of Lake Wenatchee origin. In 2001, it appears that the later migrating Osoyoos stock dominated the 2001 run passing Rock Island Dam since less than 10% of the 2001 sockeye cumulative passage index occurred before May 22 at that dam. This was not the case in 1999 and 2000 when 10% of the sockeye cumulative passage index occurred in the latter half of April. Therefore, in spite of the lower flows in 2001 compared to 2000, when weighting the two intra-year passage period’s average travel time by their associated relative passage index proportion, the annual average travel time for 2001 was shorter than that of 2000 (Figure 32).

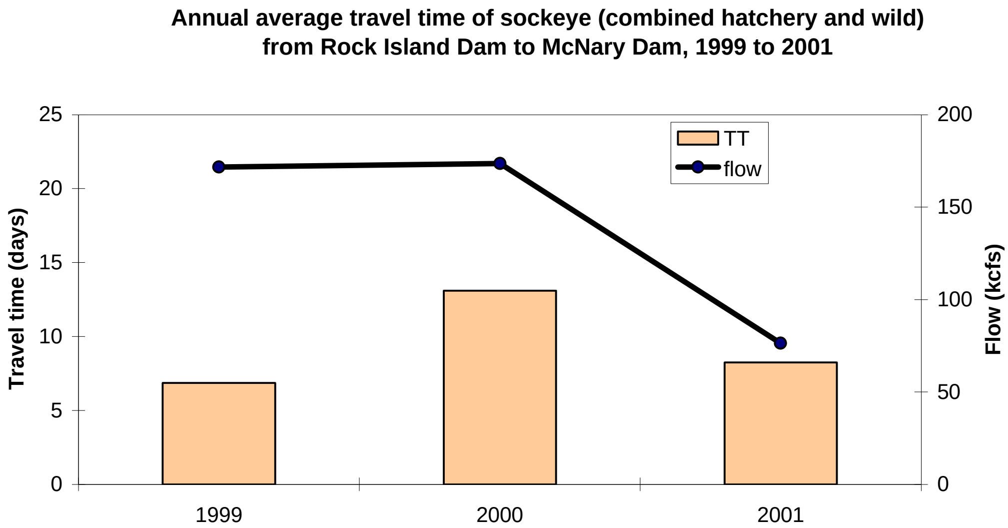

FIGURE 32. Annual average travel time of sockeye from Rock Island Dam to McNary Dam in 2001 compared to 1999 – 2000.

Subyearling chinook had consistently longer travel times between Rock Island Dam and McNary Dam in 2001 than they did for the prior two years in both the month long periods before and after July 15 (Table 35). As was observed with their Snake River basin counterparts, the general trend of decreasing average travel time over time was observed for subyearling chinook passing Rock Island Dam in all three years. Migration years 1999 to 2001 produced three very different flow levels. Average travel time increased as lower average flows decreased each year from 1999 to 2001. The 2001 average travel time of subyearling chinook increased approximately 35% over that of 2000 and approximately 50% over that of 1999, while flows dropped over 60% in 2001 from 1999 levels (Figure 33).

TABLE 35. Weighted average travel time[1] for subyearling chinook (combined hatchery and wild) from Rock Island Dam to McNary Dam within temporal blocks across three years, 1999 to 2001, and corresponding weighted average flow.

Year	Date of release at Rock Island Dam			
	6/16 - 7/15		7/16 - 8/20	
	Travel time	Flow	Travel time	Flow
1999	17.0	188.5	14.8	166.2
2000	20.9	129.6	15.3	128.9
2001	25.9	57.1	22.3	67.1

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix F Table F-18) by number of fish used to generate each daily median travel time estimate.Lower Columbia River Basin

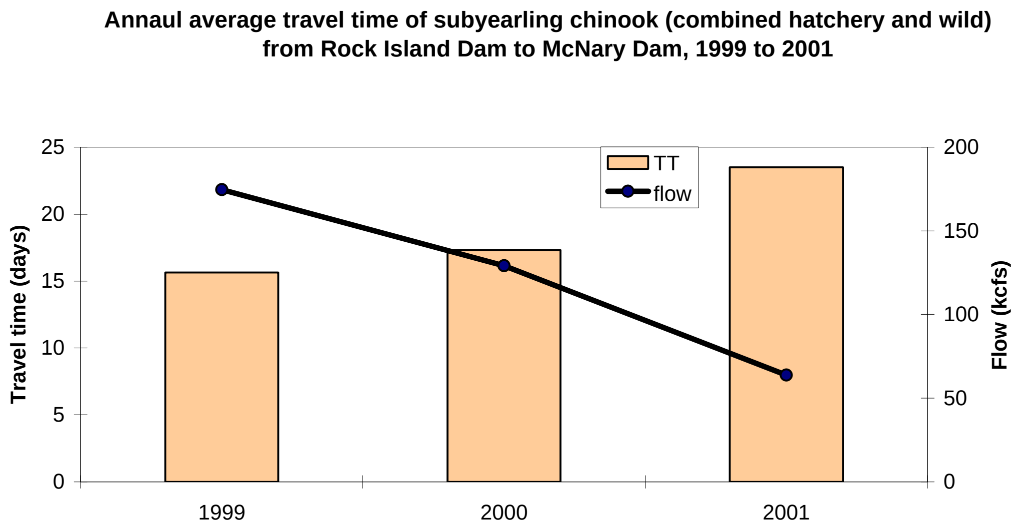

FIGURE 33. Annual average travel time of subyearling from Rock Island Dam to McNary Dam in 2001 compared to 1999 – 2000

3. Lower Columbia River Basin

McNary Dam to Bonneville Dam Index Reach

Yearling Chinook Travel Time

Weighted weekly average travel time estimates were generated for yearling chinook in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix F. A weekly averaging of the daily median travel times was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Flow was indexed at The Dalles Dam over a period of days equal to the travel time estimate and beginning at the midpoint of the weekly block. Although the week-to-week range of index flows occurring in 2001 was very narrow (ranging less than 20 Kcfs for yearling chinook), a trend of decreasing travel times over the season was still apparent (Table 36). Historically, when early and late portions of a migration season have similar flows, the later period would exhibit shorter smolt travel times. Temporal increases in yearling chinook and steelhead smoltification over time was discussed in Berggren and Filardo (1993) as a possible link.

Year 2001 had the lowest springtime flows observed of any year in the SMP, and the yearling chinook travel times that were much longer than in any of the prior three years within each weekly interval (Table 36). A weighting of each weekly average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for yearling chinook in the lower Columbia River index reach was between approximately 6 days in each of the prior three years, and was at least 40% higher in 2001 at an average of 8.5 days (Figure 34). Flows in 2001 encountered by yearling chinook in this index reach averaged only 135 Kcfs in 2001 compared to seasonal averages over 245 Kcfs in the earlier three years.

TABLE 36. Weighted average travel time[1] for weekly blocks for yearling chinook from McNary Dam to Bonneville Dam, 1998 to 2001.

		1998		1999		2000		2001	
Block	Date range	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1	4/11 - 4/17			7.3	215.8				
2	4/18 - 4/24	9.3	189.4	7.8	303.2	7.3	327.6	22.5	121.1
3	4/25 - 5/1	6.8	237.7	7.1	313.9	7.6	287.9	21.0	129.7
4	5/2 - 5/8	5.4	339.9	6.8	280.9	6.3	276.5	12.8	124.3
5	5/9 - 5/15	5.9	322.2	6.1	249.9	6.3	249.5	10.2	129.7
6	5/16 - 5/22	5.7	308.4	5.2	267.1	5.7	251.7	11.0	133.8
7	5/23 - 5/29	4.6	412.5	4.2	359.1	5.1	216.5	7.2	141.5
8	5/30 - 6/5	4.3	393.5	4.3	366.3	5.2	209.5	6.0	131.2
9	6/6 - 6/12			5	326.9	5.3	194.4	6.5	133.1

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix F Table F-24) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

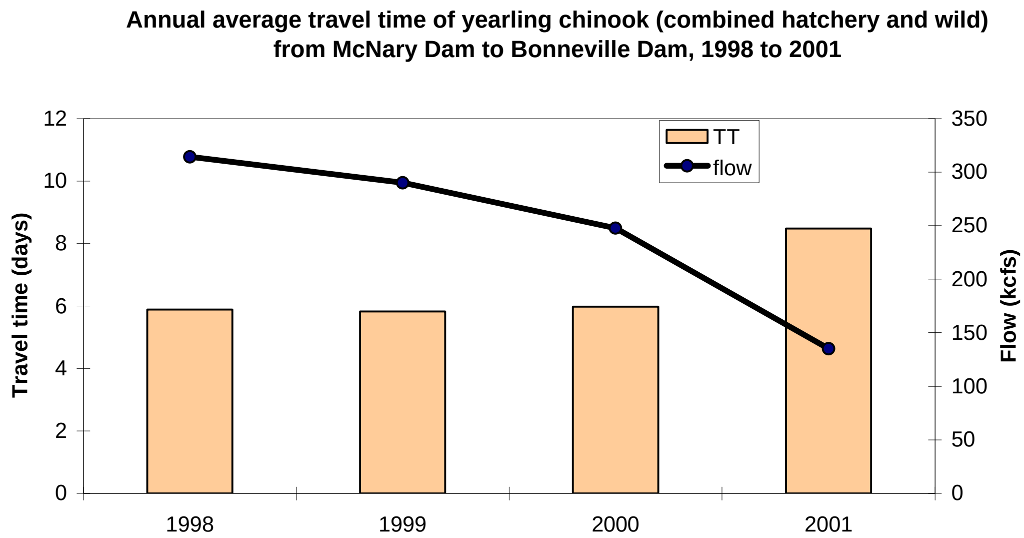

FIGURE 34. Annual average travel time of yearling chinook from McNary Dam to Bonneville Dam in 2001 compared to 1998 – 2000.

These weekly average travel times for yearling chinook were regressed against the average flow. The four years and up to nine temporal blocks were pooled to provide a single inverse exponential relation (natural logarithm of average travel time versus reciprocal of flow). The regression of average travel time and flow for the aggregate of four years was significant for yearling chinook ($P<0.01$, $R^2 = 0.72$, $\ln TT = 1.221 + 151.809/FLOW$, Figure 35). The addition of 2001 data to the regression analysis increased the slope coefficient substantially (and increased the model R^2) for yearling chinook over what was obtained last year using 1998 to 2000 data (see 2000 FPC Annual Report page 76).

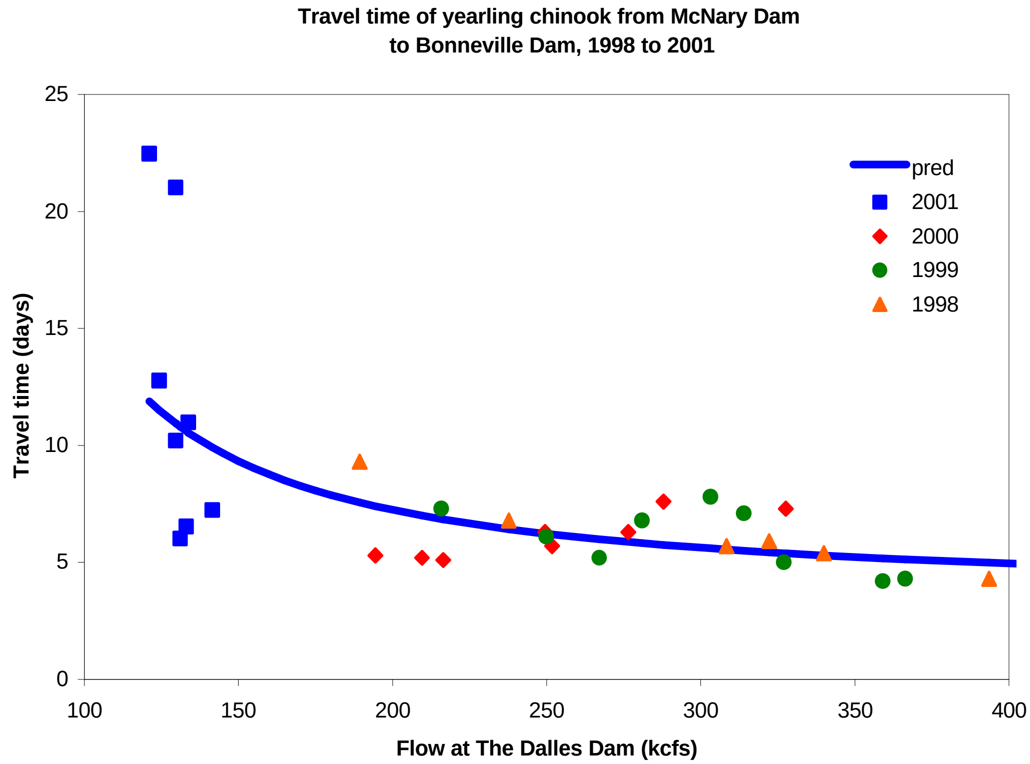

FIGURE 35. Travel time/flow relation for yearling chinook from McNary Dam to Bonneville Dam.

Steelhead Travel Time

Likewise weighted weekly average travel time estimates were generated for steelhead in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix F. The weekly estimates of survival of steelhead decreased over time in 1998, 1999, and 2001, but not in 2000. The weekly average survival of steelhead appears to closely follow the average flow, being lower when flows are higher, regardless of time of season (Table 37). Because flows remained low throughout 2001, the weekly average travel times for steelhead remained high.

A weighting of each weekly average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for steelhead in the Snake River index reach was between 5.4 and 5.7 days in the prior three years, and was over 90% longer in 2001 at an average of 11 days (Figure 36). Flows in 2001 encountered by steelhead in this index reach averaged only 133 Kcfs in 2001 compared to seasonal averages over 260 Kcfs in the earlier three years.

TABLE 37. Weighted average travel time[1] for weekly blocks for steelhead from McNary Dam to Bonneville Dam, 1998 to 2001.

		1998		1999		2000		2001	
Block	Date range	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1	4/11 - 4/17			7.3	215.8	5.1	272.5		
2	4/18 - 4/24			6.7	298.7	5.2	332.7		
3	4/25 - 5/1	6.6	237.7	6.2	314.0	5.8	284.7		
4	5/2 - 5/8	5.7	341.8	6.1	284.4	5.2	281.2	14.6	126.3
5	5/9 - 5/15	5.7	322.2	6.3	249.9	5.5	249.5	11.7	132.8
6	5/16 - 5/22	5.4	305.6	5.9	263.2	5.4	247.5	11.5	133.8
7	5/23 - 5/29	3.9	380.5	5.4	360.2	5.9	220.0	9.4	134.4
8	5/30 - 6/5	4.0	393.5	5.1	367.8	5.6	212.7	10.3	132.7

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix F Table F-25) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

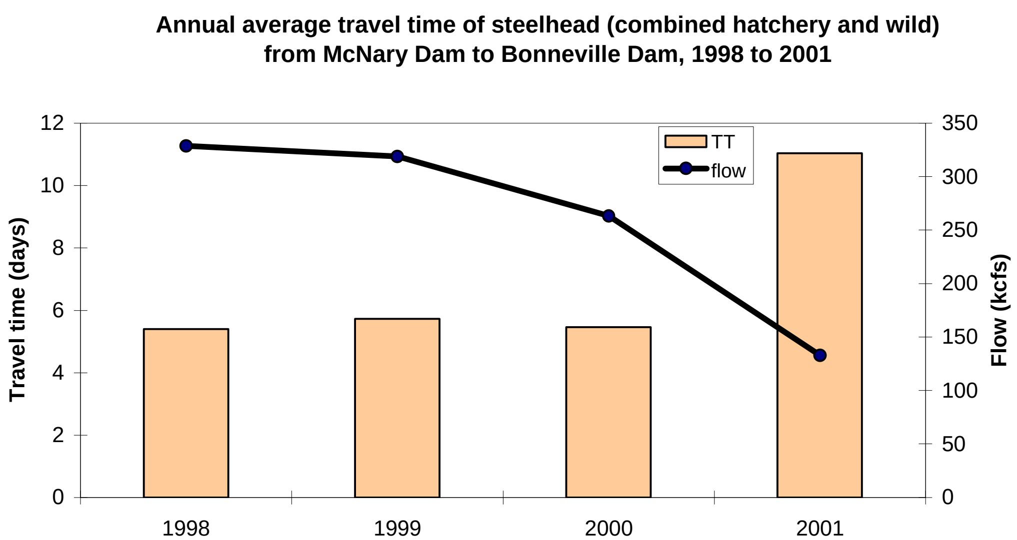

FIGURE 36. Annual average travel time of steelhead from McNary Dam to Bonneville Dam in 2001 compared to 1998 – 2000.

These weekly average travel times for steelhead were regressed against the average flow. The four years and up to nine temporal blocks were pooled to provide a single inverse exponential relation (natural logarithm of average travel time versus reciprocal of flow). The regression of average travel time and flow for the aggregate of four years was significant for steelhead ($P<0.01$,

$R^2 = 0.93$, lnTT = 1.114 + 172.313/FLOW, Figure 37). The addition of 2001 data with the lowest flows of the four years increased the slope coefficient substantially (and increased the model R^2) for steelhead over what was obtained last year based on 1998 to 2000 data (see 2000 FPC Annual Report page 76).

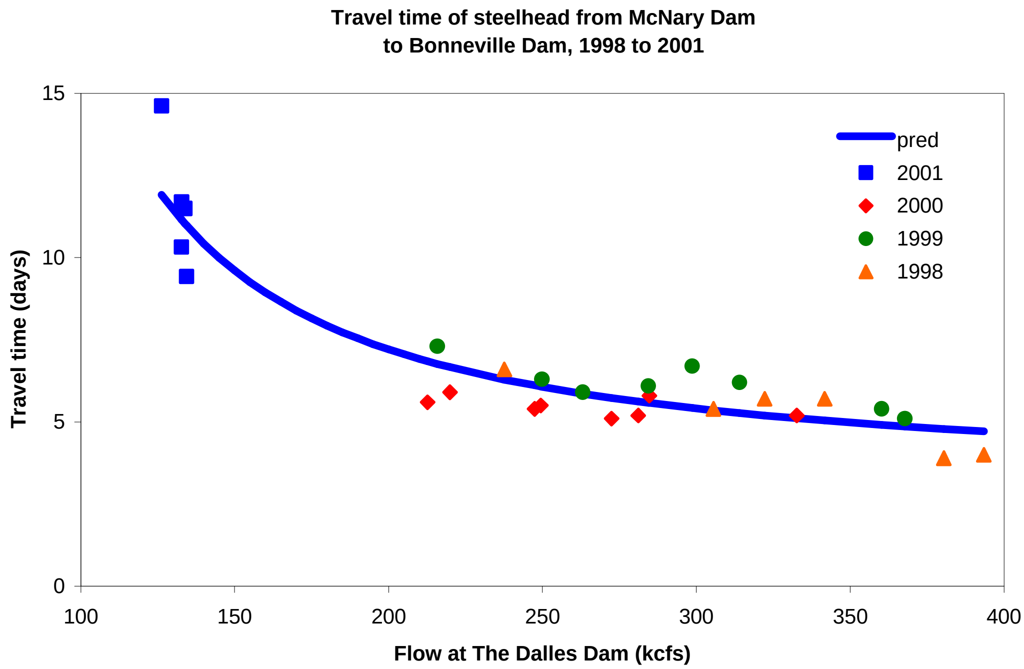

FIGURE 37. Travel time/flow relation for steelhead from McNary Dam to Bonneville Dam.

Subyearling Chinook Travel Time

Weighted estimates of travel time were generated for subyearling chinook passing McNary Dam during one-month periods before and after July 20 for 1997 to 2001. These temporal blocks were wider than the weekly blocks used with yearling chinook and steelhead because of fewer PIT tagged subyearling chinook available for analysis. PIT tagged subyearling chinook originating in both the Snake River and Mid-Columbia River basins were used in the analysis. The average travel time estimates for each temporal block were generated for subyearling chinook in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix F. The 30-day averaging of the daily median travel times and their associated The Dalles Dam flow data was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor.

The magnitude of the average travel in each period for 2001 was much higher than in the previous four years, with correspondingly much lower flows (Table 38). A weighting of each 30-day average travel time by its associated relative passage index proportion was used to produce an average travel time for each year. The annual average travel time for subyearling chinook in the Snake River index reach was between approximately 4.7 and 5.5 days in each of the prior four years, and was at least three times longer in 2001 at an average of 16.3 days (Figure 38). Flows in 2001 encountered by the subyearling chinook in this index reach averaged only 93 Kcfs in 2001 compared to seasonal averages well over 165 Kcfs in the earlier four years.

TABLE 38. Weighted average travel time[1] for subyearling chinook from McNary Dam to Bonneville Dam within temporal blocks across five years, 1997 to 2001, and corresponding weighted average flow.

Year	Date of passage at McNary Dam			
	6/20-7/20		7/21-8/31	
	Travel time	Flow	Travel time	Flow
1997	4.3	277.5	5.8	207.8
1998	5.2	199.5	7.2	159.7
1999	4.6	269.0	5.4	209.9
2000	5.3	170.8	6.1	152.2
2001	17.3	95.2	13.0	86.4

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix F Table F-26) by number of fish used to generate each daily median travel time estimate.

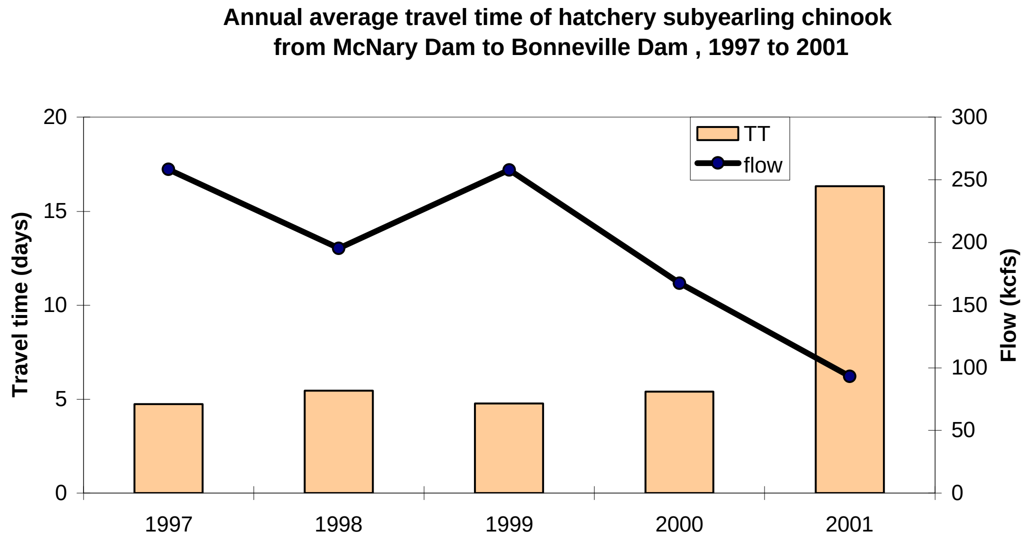

FIGURE 38. Annual average travel time of subyearling chinook from McNary Dam to Bonneville Dam in 2001 compared to 1997 – 2000.

E. Estimates of Survival

Methods

Smolt survival is estimated from release to first detection site, and between a series of dams, by the Cormack-Jolly-Seber (CJS) release-recapture method outlined in American Fisheries Society Monograph 5, *Design and analysis methods for fish survival experiments based on release-recapture*, by K.P. Burnham, D.R. Anderson, G.C. White, C. Brownie, and K.H. Pollock, 1987. This methodology is used to estimate survivals both to, and between, the dams in the hydro system possessing PIT tag detection capabilities, along with an estimate of collection efficiency at these dams. The CJS method is based on mark release-recapture theory in which the subsequent detection histories on a known number of marked fish re-released at a particular dam is used to estimate the number of fish that past that particular dam alive but undetected. The software program MARK (White and Burnham 1999) was used to perform the survival estimates with the “identity” design matrix and “identity” link function set. The program MARK provides estimates of survival between the tailraces of each detection site. Generating extended multi-dam reach survival estimates requires taking the product of a set of these shorter reach estimates. The associated variance for the extended reach estimate is computed using formulas for propagation of error in products of non-independent estimates (Meyer 1975). Extended reach survival estimates with associated 95% confidence intervals are obtained for each species, and release location and period of interest.

Sets of survival estimates are computed each year for various river reaches. In the Snake River basin, estimates of survival are made from key hatcheries to John Day Dam tailrace, from SMP traps to Lower Monumental Dam tailrace, and from Lower Granite Dam tailrace to McNary Dam tailrace. In the Columbia River basin, estimates of survival are made from key hatcheries to McNary Dam tailrace, from Rock Island Dam (release site) to McNary Dam tailrace, and from McNary Dam tailrace to John Day Dam tailrace, and specifically for yearling chinook from McNary Dam tailrace to Bonneville Dam tailrace utilizing the NMFS trawl in the lower Columbia River as the final detection site. The goal is to have at least 600 PIT tagged smolts released (or detected and re-released at the starting site) in each group for which survival estimates are desired. Generally, release periods of a week are attempted, but in some instances release periods of up to 15 consecutive days were required to try to achieve the release quota. Detailed results for the individual release (or detected and released) groups of interest are present in Appendix G.

For SMP traps and key dams, the 2001 survival data is summarized as annual averages for comparison to recent past years. A single seasonal average survival estimates is obtained for those PIT tagged groups released over time that do not differ significantly. Testing whether the "between group" variance component was significantly greater than zero (Burnham 1987 *et al.*, Chapter 4) was used to determine if significant differences occurred within a year. This is a chi-square test equal to [empirical variance of mean survival*(1-degrees of freedom)]/ [theoretical variance of mean survival]. In cases where the chi-square test was not significant at the 95% confidence level, then the average was computed for the season, along with the average theoretical variance. In cases where the chi-square test was significant, then the season was split into periods showing the different survival levels.

Results

1. Snake River Basin

Trap Release Site to Lower Monumental Dam Tailrace Reach

The 2001 seasonal survival estimate for PIT tagged wild and hatchery chinook released from the Salmon, Imnaha, Grande Ronde, and Snake River traps to Lower Monumental Dam tailrace averaged between 52.9% and 76.4% (Table 39), and that of wild and hatchery steelhead averaged between 41.3% and 63.7% (Table 40). Based on non-overlapping 95% confidence intervals, the 2001 survival estimates were significantly lower than the survival estimates of 1998 to 2000 for PIT tagged wild and hatchery chinook released from the Salmon River trap and wild chinook released from the Imnaha River trap. PIT tagged chinook released from the Grande Ronde River trap and Snake River trap, which have fewer miles to migrate to the dams, had overlapping 95% confidence intervals across these four years. Hatchery steelhead released from these four traps had estimated survival in 2001 ranging from 41 to 51%, which were significantly lower than the corresponding survival estimates in 1998 and 1999 for most traps, but not significantly different than 2000 in three of the four trap releases. Wild steelhead released after May 1 had significantly lower survival in 2001 than in 1999 and 2000 for the three traps with data available in these three years, averaging less than 45% survival in 2001 compared to over 70% in 5 of 6 cases for 1999 and 2000 with fish from these three traps. In general, the highest survival estimates occurred during 1998 and 1999 when flows were higher than in 2000 and 2001.

TABLE 39. Annual average reach survival estimates of Snake River basin PIT tagged yearling chinook from trap release sites to Lower Monumental Dam tailrace in 2001 compared to 1998 – 2000.

Tag Site	Species	Rearing Type	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Salmon River trap								
	Chinook	Wild	1998	3/23-5/1	3	0.777	0.697	0.857
		Wild	1999	3/18-4/30	5	0.809	0.775	0.844
		Wild	2000	3/27-4/21	4	0.763	0.690	0.835
		Wild	2001	3/19-5/4	4	0.583	0.547	0.619
		Hatchery	1998	4/6-5/1	3	0.679	0.618	0.740
		Hatchery	1999	3/18-5/21	8	0.694	0.660	0.729
		Hatchery	2000	3/13-5/5	8	0.690	0.602	0.777
		Hatchery	2001	3/19-5/17	8	0.629	0.605	0.653
Snake River trap								
	Chinook	Wild	1998	3/25-5/8	2	0.767	0.669	0.865
		Wild	1999	3/22-5/25	5	0.861	0.832	0.891
		Wild	2000	4/10-4/28	3	0.916	0.779	1.052
		Hatchery	1998	4/13-5/8	4	0.797	0.729	0.865
		Hatchery	1999	4/5-5/25	5	0.884	0.842	0.926
		Hatchery	2000	4/10-5/5	4	0.770	0.672	0.868
		Hatchery	2001	4/27-5/4	1	0.745	0.666	0.825
Imnaha River trap								
	Chinook	Wild	1998	3/16-4/23	6	0.751	0.707	0.795
		Wild	1999	3/28-5/14	5	0.806	0.775	0.837
		Wild	2000	3/13-4/23	4	0.757	0.699	0.815
		Wild	2001*	3/14-4/27	14	0.683	0.669	0.697
		Wild	2001*	4/29-5/12	1	0.529	0.475	0.583
		Hatchery	1998*	4/8-4/9	1	0.583	0.512	0.655
		Hatchery	1998*	4/13-4/14	1	0.738	0.624	0.853
		Hatchery	1999	4/4-4/16	2	0.610	0.554	0.665
		Hatchery	2000	3/20-4/16	4	0.535	0.445	0.626
		Hatchery	2001*	3/23-3/28	1	0.611	0.556	0.665
		Hatchery	2001*	3/29-4/27	5	0.712	0.684	0.740
Grande Ronde River trap								
	Chinook	Wild	1998	3/24-5/8	2	0.699	0.600	0.798
		Wild	1999	4/12-4/30	1	0.825	0.756	0.894
		Wild	2000	4/3-5/5	5	0.775	0.650	0.900
		Wild	2001	3/28-5/3	2	0.764	0.694	0.835
		Hatchery	1998	4/8-4/9	1	0.776	0.619	0.934
		Hatchery	1999*	3/17-3/26	1	0.580	0.523	0.637
		Hatchery	1999*	3/29-4/9	1	0.706	0.634	0.779
		Hatchery	2001	4/2-4/26	3	0.624	0.578	0.670

* Identifies a year with a significant “between blocks (temporal releases)” variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly. No survival estimates are available for wild chinook from the Snake River trap in 2001 and hatchery chinook from the Grande Ronde River trap in 2000 due to not enough PIT tagged fish being released.

TABLE 40. Annual average reach survival estimate of Snake River basin PIT tagged steelhead from trap release sites to Lower Monumental Dam tailrace in 2001 compared to 1998 - 2000.

Tag Site	Species	Rearing Type	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Salmon River trap								
	Steelhead	Wild	2001	4/23-5/4	1	0.476	0.367	0.585
		Hatchery	1998	4/20-5/1	2	0.814	0.723	0.905
		Hatchery	1999	4/14-5/21	4	0.692	0.651	0.733
		Hatchery	2000	4/17-5/19	4	0.514	0.398	0.629
		Hatchery	2001	4/9-5/18	3	0.413	0.329	0.496
Snake River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.816	0.739	0.893
		Wild	2000	4/17-5/5	3	0.743	0.622	0.865
		Wild	2001	4/27-5/21	2	0.452	0.392	0.513
		Hatchery	1998	4/6-5/23	7	0.728	0.683	0.773
		Hatchery	1999*	4/19-4/30	2	0.874	0.817	0.930
		Hatchery	1999*	5/3-5/25	2	0.717	0.676	0.758
		Hatchery	2000	4/17-5/26	4	0.692	0.580	0.803
		Hatchery	2001	4/27-5/21	3	0.465	0.365	0.565
Imnaha River trap								
	Steelhead	Wild	1999	5/10-5/20	2	0.784	0.733	0.835
		Wild	2000	4/17-5/21	5	0.611	0.508	0.714
		Wild	2001*	3/20-4/1 & 5/1-5/15	5	0.445	0.405	0.484
		Wild	2001*	4/15-4/30	2	0.637	0.555	0.719
		Hatchery	1998	4/27-5/22	4	0.635	0.589	0.681
		Hatchery	1999	4/11-6/24	5	0.711	0.680	0.742
		Hatchery	2000	4/17-5/21	5	0.551	0.463	0.639
		Hatchery	2001	4/15-5/15	6	0.450	0.376	0.525
Grande Ronde River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.806	0.747	0.866
		Wild	2000	4/5-4/28	4	0.729	0.614	0.843
		Wild	2001*	4/23-5/1	1	0.547	0.401	0.692
		Wild	2001*	5/7-5/21	1	0.298	0.199	0.397
		Hatchery	1998	4/24-5/15	4	0.632	0.586	0.678
		Hatchery	1999	4/19-5/25	3	0.720	0.678	0.761
		Hatchery	2000	4/10-5/12	4	0.561	0.489	0.633
		Hatchery	2001	4/23-5/17	3	0.511	0.408	0.614

* Identifies a year with a significant "between blocks (temporal releases)" variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly. No wild steelhead estimates are available for 1998 due to estimation bias (see pages 67-68 of 1998 FPC Annual Report).

Lower Granite Dam Tailrace to McNary Dam Tailrace Index Reach

In the reach from Lower Granite Dam tailrace and McNary Dam tailrace (*i.e.*, Snake River index reach), the estimated survival of weekly cohorts of yearling chinook and steelhead (each weekly cohort is an aggregate of smolts from all upstream origins that passed Lower Granite Dam during a particular date range) changed significantly starting May 20 (Table 41 and Appendix G Table G-4). Survival estimates for wild and hatchery yearling chinook decreased by about 50% in the week after May 20 and that of wild chinook decreased another 50% after May 27, while the post-May 20 survival estimates for hatchery steelhead dropped to less than 25% of the earlier date period. Increasing numbers of chinook and steelhead smolts residualizing in the reservoirs and not continuing to migrate due to the extremely low flows in 2001 contributed to the low survival estimated after May 20. Interestingly, the problem was more severe in steelhead compared to yearling chinook.

TABLE 41. Average reach survival estimates of Snake River basin PIT tagged yearling chinook and steelhead from Lower Granite Dam tailrace to McNary Dam tailrace in 2001.

Species	Date Range	No. of Blocks*	Average Survival	Lower Limit	Upper Limit
Hatchery Chinook					
	4/1-5/12	6	0.565	0.540	0.591
	5/13-5/19	1	0.438	0.405	0.471
	5/20-6/2	2	0.194	0.128	0.259
Wild Chinook					
	4/15-4/28	2	0.596	0.570	0.621
	4/29-5/12	2	0.521	0.499	0.543
	5/13-5/19	1	0.439	0.404	0.473
	5/20-5/26	1	0.229	0.192	0.265
	5/27-6/2	1	0.118	0.087	0.150
Hatchery Steelhead					
	4/22-5/19	4	0.172	0.153	0.192
	5/20-5/26	1	0.041	0.025	0.057
Wild Steelhead					
	4/22-5/19	4	0.172	0.156	0.189

* When there is a significant "between blocks (temporal releases)" variance component, the survival estimates are presented separately for each set of blocks that differ significantly.

The annual average survival of combined wild and hatchery yearling chinook and steelhead that migrated in-river from Lower Granite Dam tailrace to McNary Dam tailrace in 2001 was 57% for yearling chinook and 16% for steelhead (Figure 39). This annual survival estimate was 25% lower for yearling chinook than what NMFS reported for 2000, and a staggering 76% lower for steelhead. Due to no spill and full transportation of non-PIT tagged smolts from Lower Granite, Little Goose, and Lower Monumental dams in 2001, the proportion of the smolt run that continued migrating in-river past these three dams to McNary Dam was about 2% or less for yearling chinook and steelhead in 2001 (Appendix I) compared to about 29% for yearling chinook and 19% for steelhead in 2000 (FPC 2000 Annual Report, Appendix G Table G-4). Therefore, with a smaller proportion of non-PIT tagged smolts migrating in-river in 2001 compared to 2000, the overall effect of lower in-river survival in 2001 compared to 2000 for fish originating above Lower Granite Dam may be somewhat offset by transportation provided survival of transported fish is similar between these two years. That determination will require waiting for the adult returns of the PIT tagged smolts from these two years.

Several factors may have contributed to the lower in-river survival in 2001 in the Snake River index reach. First the low flows and resulting higher water clarity would increase the opportunity for predation by other fish and birds on the migrating smolts. Smolt travel time estimates in 2001 were much longer than in recent past years, thus increasing their exposure time to predation. Second, the in-river migrating smolts passed all four dams in the Snake River without spill in 2001, so for PIT tagged smolts the available routes of passage was either the bypass channel or turbines (only the turbine route was available for the non-PIT tagged smolts), which have a lower measured survival than the spill route from earlier NMFS studies. Third, steelhead smolts seem more prone to not migrate if flows are too low and simply residualize and overwinter until the next spring, as was documented during 1992 when very low flows resulted in larger than usual numbers of “hold-over” steelhead migrating in early April of the following year. In migration year 1992 daily average flows remained below 85 Kcfs during the springtime, whereas migration year 2001 has springtime flows averaging less than 65 Kcfs.

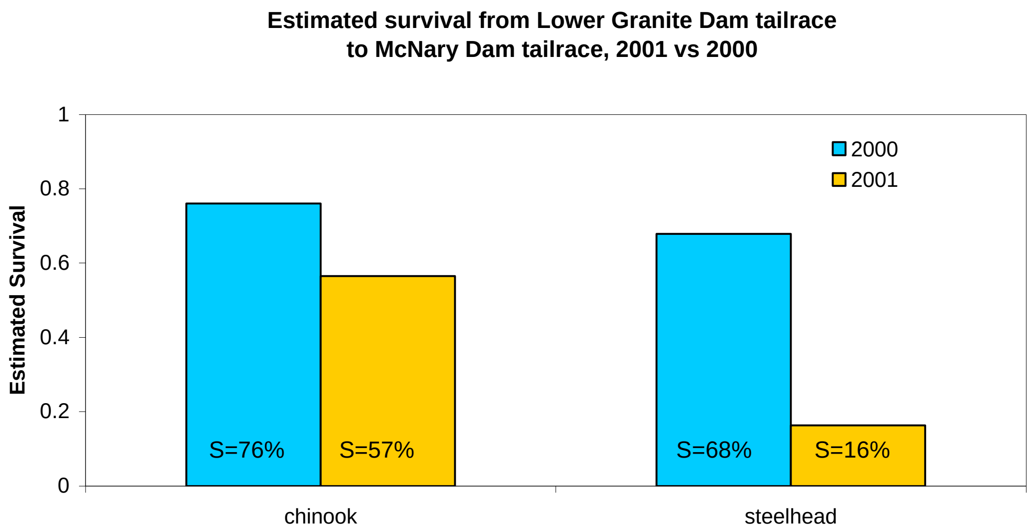

FIGURE 39. Estimated annual survival of in-river migrating PIT tagged yearling chinook and steelhead from Lower Granite Dam tailrace to McNary Dam tailrace in 2001 compared to NMFS estimates of annual survival in 2000.

Snake River Basin Hatchery Release Site to John Day Dam Tailrace Reach

The 2001 estimates of survival for PIT tagged hatchery chinook from the hatchery release site to the tailrace of John Day Dam ranged from 20.5% (Catherine Creek acclimation pond) to 41.8% (Imnaha River acclimation pond), with McCall, Dworshak, and Rapid River hatcheries being at intermediate levels of 26.5%, 28.0%, and 36.5%, respectively (Table 42). With the exception of Imnaha River hatchery chinook, these survival estimates were lower than any of the past three years' estimates, and substantially lower than in 1999 and 2000.

The most dramatic reduction in survival in 2001 was observed with steelhead. The estimated survival of steelhead from release at Dworshak Hatchery to John Day Dam tailrace was only 6.4%, which is less than one-sixth of the survival estimated (always greater than 40%) in the past three years (Table 42).

TABLE 42. Annual average reach survival estimates of Snake River basin PIT tagged yearling hatchery chinook and hatchery steelhead from release site to John Day Dam tailrace in 2001 compared to 1998 – 2000.

Tag Site	Species	Year	Date Range*	Release Number	Survival	Lower Limit	Upper Limit
McCall Hatchery							
	Chinook	1998	3/30	47340	0.374	0.328	0.420
		1999	4/6-4/7	47985	0.549	0.390	0.708
		2000	4/3-4/5	47709	Estimate not available to JDA		
		2001	3/26-3/29	55129	0.265	0.184	0.346
Rapid River Hatchery							
	Chinook	1998	V: 3/16-4/21	48339	0.440	0.349	0.532
		1999	V: 3/18-4/26	47813	0.578	0.470	0.686
		2000	V: 3/17-4/25	47748	0.522	0.325	0.719
		2001	V: 3/15-4/24	55091	0.365	0.309	0.422
Imnaha Acclimation Pond							
	Chinook	1998	4/6	19827	0.409	0.336	0.481
		1999	V: 3/16-4/16	19939	0.474	0.405	0.544
		2000	V: 3/22-4/18	20819	0.425	0.264	0.586
		2001	V: 3/21-4/16	20922	0.418	0.340	0.497
Dworshak Hatchery							
	Chinook	1998	3/25-3/26	47704	0.477	0.296	0.657
		1999	4/7-4/8	47845	0.560	0.456	0.664
		2000	3/23; 4/5-4/6	47745	0.513	0.349	0.678
		2001	3/28	55142	0.280	0.247	0.313
Catherine Ck Acc. Pond							
	Chinook	2001	V: 4/1-4/16	20915	0.205	0.105	0.304
Dworshak Hatchery							
	Steelhead	1998	4/27-4/30	1500	0.500	0.347	0.652
		1999	4/26-4/30	3715	0.481	0.408	0.554
		2000	5/3-5/5	4208	0.408	0.101	0.714
		2001	4/23-4/26	4205	0.064	0.024	0.104

* date range of volitional release is denoted with letter V.

2. Mid-Columbia River Basin

Mid-Columbia River Basin Hatchery Release Site to McNary Dam Tailrace

The 2001 survival for PIT tagged hatchery yearling chinook released from Leavenworth and Winthrop hatcheries was estimated at 50.1% and 42.7%, respectively, to McNary Dam tailrace (Table 43). These survival estimates are 10-42% lower than in the past three years. The estimated survival of subyearling chinook released from Wells Hatchery to McNary Dam tailrace was 21.1%, nearly the same as last year, but over 38% lower than in the prior two years. The 2001 survival estimates for subyearling chinook released from Priest Rapids and Ringold hatcheries to McNary Dam tailrace were similar to those of 1999 and higher than those of 2000.

TABLE 43. Annual average reach survival estimates of Mid-Columbia River basin PIT tagged yearling and subyearling hatchery chinook from release site to McNary Dam tailrace in 2001 compared to 1998 – 2000.

Tag Site	Species	Age	Year	Release Date Range	Survival	Lower Limit	Upper Limit
Winthrop NFH							
	Chinook	1	1998	4/14	0.608	0.478	0.739
			1999	4/15	0.568	0.527	0.609
			2000	4/10	0.483	0.419	0.546
			2001	4/17	0.427	0.409	0.445
Leavenworth NFH							
	Chinook	1	1998	4/20	0.546	0.491	0.602
			1999	4/19	0.586	0.550	0.622
			2000	4/18	0.593	0.520	0.667
			2001	4/17	0.501	0.484	0.517
Wells SFH							
	Chinook	0	1998	6/10	0.291	0.241	0.340
			1999	6/19	0.373	0.281	0.465
			2000	6/19	0.210	0.168	0.253
			2001	6/20	0.211	0.166	0.257
Priest Rapids SFH							
	Chinook	0	1999	6/14-6/23	0.757	0.679	0.836
			2000	6/15-6/27	0.666	0.577	0.755
			2001	611-6/19	0.746	0.670	0.794
Ringold SFH							
	Chinook	0	1999	6/16	0.835	0.740	0.929
			2000	6/17-6/19	0.540	0.475	0.604
			2001	6/20-6/21	0.732	0.684	0.780

Rock Island Dam to McNary Dam Tailrace Index Reach

The 2001 seasonal average survival estimates for fish PIT tagged (mixture of hatchery and wild fish) and released from Rock Island Dam to the tailrace of McNary Dam were 55.2% for yearling chinook, 18.6% for steelhead, 63.6% for sockeye, and 32.9% for subyearling chinook before July 20 and 22.0% afterwards (Table 44 and Figure 40 to Figure 42). The 2001 seasonal estimates were lower than in the past three years for PIT tagged smolts except sockeye, however, the sockeye survival estimates have had wide confidence intervals in 2000 and 2001. The most dramatic reduction in survival was estimated for steelhead. The 2001 survival estimate was over 200% lower than in the prior three years (Figure 41).

TABLE 44. Annual average reach survival estimates of Mid-Columbia River basin PIT tagged smolts (mixture of wild and hatchery fish) from release at Rock Island Dam to McNary Dam tailrace in 2001 compared to 1998 - 2000.

Tag Site	Species	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Rock Island Dam							
	Chinook	1998	4/19-6/2	6	0.712	0.555	0.868
	Age 1	1999	4/20-5/31	3	0.750	0.673	0.827
		2000	4/21-6/2	3	0.833	0.674	0.992
		2001	4/23-6/6	2	0.552	0.481	0.623
Rock Island Dam							
	Steelhead	1998	4/24-5/22	7	0.595	0.504	0.686
		1999	4/20-5/22	3	0.639	0.578	0.699
		2000	4/21-6/2	3	0.663	0.490	0.837
		2001	5/1-6/3	4	0.186	0.124	0.249
Rock Island Dam							
	Sockeye	1998	4/15-5/19	6	0.682	0.559	0.805
		1999*	4/20-5/3	1	0.650	0.561	0.739
		1999*	5/4-5/22	1	0.456	0.381	0.532
		2000	4/21-5/24	2	0.634	0.183	1.085
		2001	5/23-6/1	1	0.636	0.350	0.922
Rock Island Dam							
	Chinook	1998	6/24-7/21	5	0.616	0.541	0.690
	Age 0	1999	6/17-7/31	3	0.549	0.469	0.630
		2000	6/19-8/19	5	0.596	0.516	0.676
		2001*	6/26-7/18	3	0.329	0.281	0.377
		2001*	7/20-7/27	1	0.220	0.164	0.277

* Identifies a year with a significant “between blocks (temporal releases)” variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly.

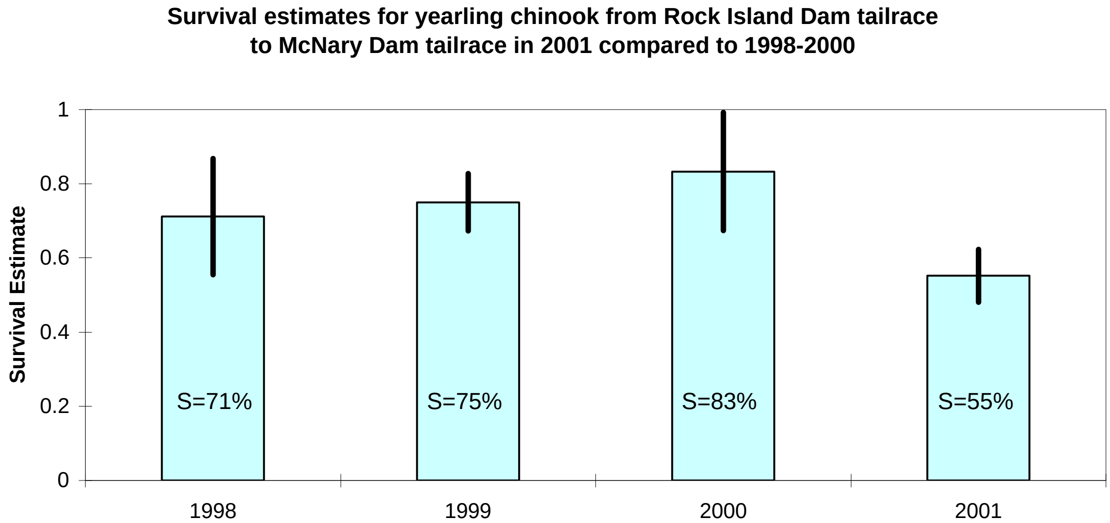

FIGURE 40. Estimated annual survival for yearling chinook from Rock Island Dam tailrace to McNary Dam tailrace in 2001 compared to 1998 – 2000.

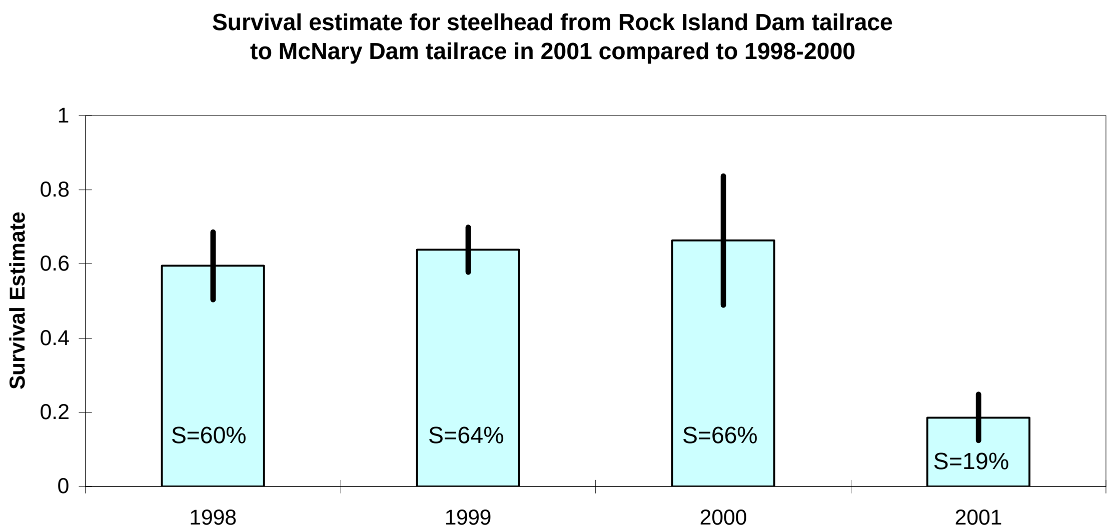

FIGURE 41. Estimated annual survival for steelhead from Rock Island Dam tailrace to McNary Dam tailrace in 2001 compared to 1998 – 2000.

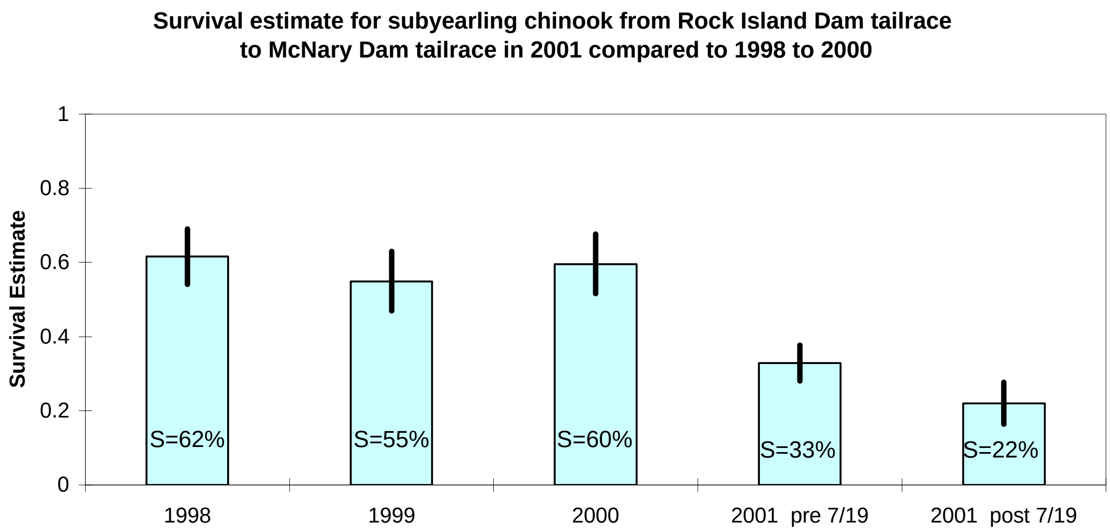

FIGURE 42. Estimated annual survival for subyearling chinook from Rock Island Dam tailrace to McNary Dam tailrace in 2001 compared to 1998 - 2000.

3. Lower Columbia River Basin

McNary Dam Tailrace to Bonneville Dam Tailrace Index Reach

The annual average survival of combined wild and hatchery yearling chinook and steelhead in the index reach from McNary Dam tailrace to Bonneville Dam tailrace (*i.e.*, lower Columbia River index reach) in 2001 was 53% for yearling chinook and 23% for steelhead (Figure 43). This annual survival estimate was 17% lower for yearling chinook than what NMFS reported for 2000, and 60% lower for steelhead. Although the PIT tag data used to estimate survival in the lower Columbia River includes both smolts from the Snake River and Mid-Columbia River basins, nearly all smolts migrating in-river between McNary and Bonneville dams in 2001 were of Mid-Columbia and lower Columbia River origin. As shown in Appendix I, approximately 99% of yearling chinook and steelhead and 96% of subyearling chinook originating in the Snake River basin above Lower Granite Dam were transported in 2001. For the Mid-Columbia River basin smolts, approximately 35% of yearling chinook, 30% of steelhead, and 58.5% of subyearling chinook were transported at McNary Dam in 2001. The remaining Mid-Columbia River origin smolts and all lower Columbia River origin smolts experienced conditions of low flows and only late-season spills when migrating in the lower Columbia River reach.

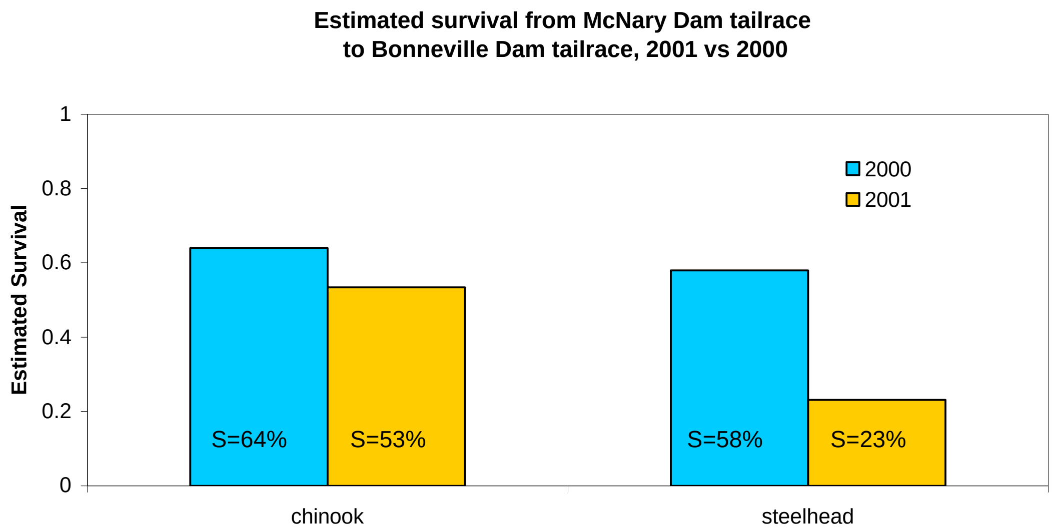

FIGURE 43. Estimated annual survival of in-river migrating PIT tagged yearling chinook and steelhead from McNary Dam tailrace to Bonneville Dam tailrace in 2001 compared to NMFS estimates of annual survival in 2000.

Further analysis of smolt survival in the lower Columbia River index reach in 2001 was performed with the year split into periods of passage at McNary Dam. Initially the McNary Dam passage distribution of PIT tagged yearling chinook was split into nine multi-day blocks with at least 10,000 PIT tagged smolts per block. The resulting survival estimates from McNary Dam tailrace to either John Day Dam tailrace or Bonneville Dam tailrace was presented in a memo in Appendix A and repeated in the chapter on spill in the main body of this annual report. A plot of the estimated survival from McNary Dam tailrace to Bonneville Dam tailrace shows evidence of shifts in estimated survival for yearling chinook smolts passing McNary Dam in the May 1-10, May 11-21, and May 22-June 9 periods (Figure 44). One likely explanation of this apparent grouping of the survival data was that spill in the lower Columbia River index reach did not begin at The Dalles and Bonneville dams until May 16 nor at John Day Dam until May 25.

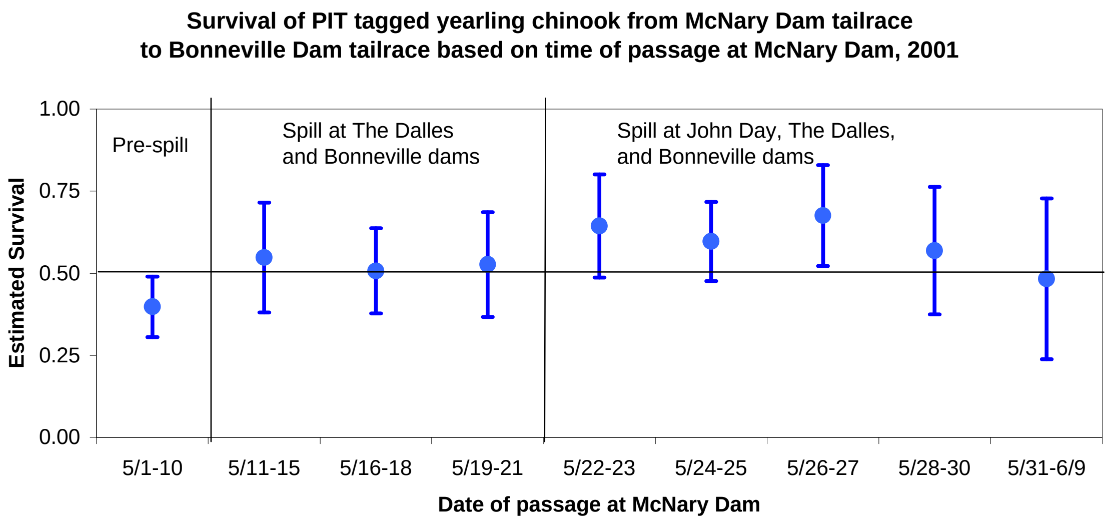

FIGURE 44. Estimated survival from McNary Dam tailrace to Bonneville Dam tailrace for yearling chinook passing McNary Dam during various time periods in 2001.

4. Combined Snake River and Lower Columbia River Basins

Lower Granite Dam Tailrace to Bonneville Dam Tailrace Index Reach

Estimated survival of PIT tagged smolts migrating in-river from Lower Granite Dam tailrace to Bonneville Dam tailrace was only 30% for yearling chinook and 4% for steelhead (Figure 45). Because only about 1% of the untagged yearling chinook and steelhead originating above Lower Granite Dam migrated in-river from Lower Granite Dam to Bonneville Dam, the importance of presenting these two survival estimates is in showing how much worse the conditions of 2001 were on steelhead than on yearling chinook. Estimated survival was 7.5 times higher for yearling chinook than steelhead in the full Snake-lower Columbia index reach. Earlier we documented that the relation between smolt travel time and flow was much stronger for steelhead than yearling chinook. The steelhead migration period begins later than that of yearling chinook and appears more timed to coincide with the higher flows typical in May. If the resulting late spring flows are low, water temperatures begin to raise sooner. Under these conditions, steelhead begin to residualize and overwinter until the following spring. The lower numbers of steelhead that continue to migrate do so in waters that are slower, clearer, and warmer. The conditions make predation by other fish and birds more successful than when waters are faster, colder, and more turbid.

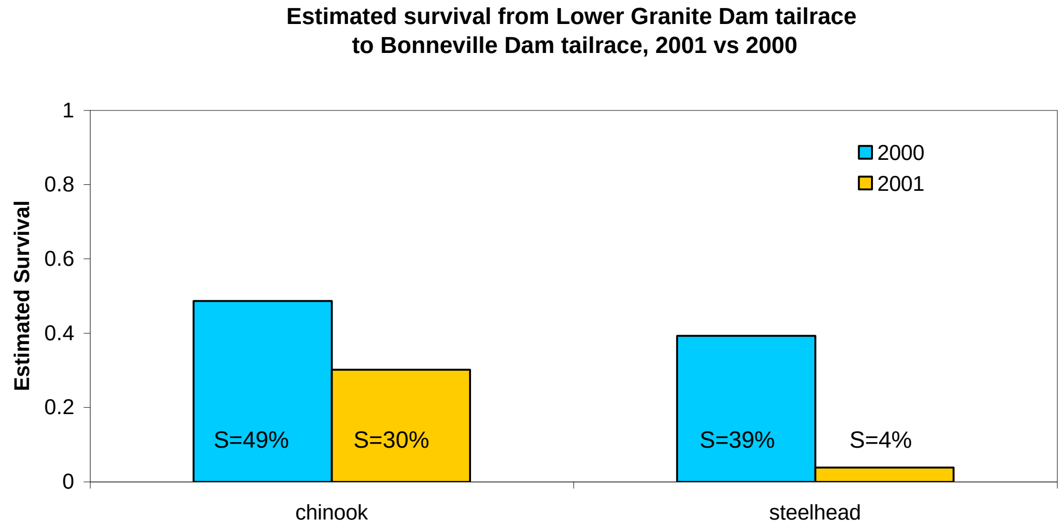

FIGURE 45. Estimated annual survival of in-river migrating PIT tagged yearling chinook and steelhead from Lower Granite Dam tailrace to Bonneville Dam tailrace in 2001 compared to NMFS estimates of annual survival in 2000.

F. Conclusions

In summary, the near record low runoff volume observed in 2001, energy regulation, volatile wholesale power markets and BPA energy and financial emergencies combined to produce the poor migration conditions that occurred. Under these conditions:

- Up to 99% of Snake River yearling chinook and steelhead were transported from the Snake River collector projects and McNary Dam. Approximately 96% of juvenile Snake River subyearling migrants were transported from these projects. For Mid Columbia origin fish an estimated 35% of yearling chinook, 30% of steelhead and 59% of subyearling chinook were transported from McNary Dam. Transportation as a management action is not available to fish originating below McNary Dam.
- Since not all migrants are representatively marked above Lower Granite Dam, it is difficult to ascertain the population survival based on specific mark releases by expanding to the popula-

tion. However, in 2001 a pattern in survival emerged that was not observed in the data collected in recent past years. Based on collection data for the run-at-large that was subsequently expanded to population estimates, the juvenile survival to Lower Granite Dam for hatchery and wild yearling chinook was the lowest observed in the last 4 years. This assessment was based on the comparison of the ratios of the estimated juvenile smolt population size at Lower Granite Dam of hatchery and wild yearling chinook to the hatchery release numbers and the redd count indices, respectively.

- This same observation of the lowest survival to Lower Granite Dam was observed for juvenile steelhead migrants.
- Average flows during the spring and summer migration were the lowest observed since travel time information has been collected using fish marked with PIT tags. These observations have allowed the development of a relation between flow and travel time over a wide range of flows, where travel time is strongly correlated with flow.
- In 2001, travel time estimates for yearling chinook and steelhead through the hydro system were approximately twice as long as observed historically.
- The low flows in 2001 affected the steelhead travel time and reach survival to an even greater degree than observed for chinook.
- River conditions produced the lowest survival estimates for yearling chinook and steelhead in 2001 compared to 2000 and the past years since using PIT tagged fish for estimating survivals in each major index reach in the Snake, Mid Columbia, and lower Columbia rivers.

G. Citations

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IV. ADULT FISH PASSAGE

A. Overview

Annually, adult salmon (all species and races) along with other anadromous fish such as lamprey, shad, and resident fishes are counted as they migrate upstream past mainstream Columbia and Snake River dams. These fish are either videotaped as they pass through the counting slots or are directly counted by personnel. Fish counting seasons normally run from early spring through late fall. WDFW contracts to count fish at COE projects while the PUD contract personnel to count adult fish at their dams. Daily counts from each dam are reported to the COE and final data are compiled and incorporated in an annual Fish Passage Report by the COE. In addition, fish counts are daily updated on Web sites including the FPC Web site.

The FPC reports on adult fish passage and passage conditions at the dams throughout the adult fish migration. The FPC Weekly Report incorporates adult fish counts for that season and compares that total to the previous year as well as the 10-year average through the same block of time. An annual report titled Adult Fishway Inspections at the Mainstream Snake and Columbia River Dams summarizes inspections made at the COE and PUD projects. The inspections are completed to assure that adult fishways are maintained at acceptable criteria levels throughout the fish passage season. State and Federal fish agencies complete the fish facilities inspections.

Some general conditions occurring during the 2001 adult fish passage season that might have affected fish passage at the mainstream dams are listed.

- Water temperatures warmed to the lower 70°F during the summer and late fall 2001 and caused some delay in the steelhead passage.
- Aquatic grasses such as milfoil are becoming more plentiful in the Columbia River and have spread to the lower river. In recent years greater quantities of these grasses are drifting down to the projects, at times, these grasses can be a major problem when they become entrained on diffusion gratings, intake screens, and other places that require additional maintenance to clear.
- River flows during the spring and early summer were much lower than normal, and reduced flows resulted in less spill at the mainstem dams. However, adult fish passage conditions appeared excellent during the spring and early summer months. Fallback was minimal this year and adult salmon moved quickly upstream with few delays based on radio telemetry stud-

ies conducted by the University of Idaho Fisheries Resource Office. Personnel at the Lower Granite Dam trapping site reported few fish with head burn symptoms (<1%) (personal communication with NMFS) while about 13% of the spring and summer chinook had evidence of marine mammal attacks .

- The COE and PUD should continue to upgrade fish facilities, especially in regard to protecting increasing numbers of adult fish that are presently returning to the Columbia River and tributaries.

B. Adult Fish Counts

Overall, this season's return of adult salmon to the Columbia River was extraordinary, with record-breaking fish counts for most species of salmon at Bonneville Dam and many upriver sites. About 868,000 adult chinook salmon, 260,000 coho salmon, 115,000 sockeye salmon and 633,000 steelhead were counted at Bonneville Dam in 2001. Whether adult returns will stay at these high levels remains a question. Some encouraging signs prevail, such as excellent jack returns to many facilities provide hope that the numbers of adult fish will rebuild to a point that harvestable numbers will be available in future years throughout the Columbia River Basin. Adult returns to mainstem dams are summarized for the various species and runs of salmon for year 2001.

1. Spring Chinook Salmon

In 2001, the counted total of adult spring chinook salmon returning to Bonneville Dam was a record-high 391,367, more than double the near record high total of 178,600 that returned in 2000. The 2001 record return of spring chinook to Bonneville Dam included a sports fishery downstream of Bonneville Dam; the first since the 1970s. This year's adult run was comprised of a mixture of 3-, 4- and 5-year old fish that spend one to three years of their life cycle in the ocean. About 88% of the 2001 adult spring chinook run was comprised of 4-year old chinook based on sampling results completed at the Bonneville Dam adult trapping facility by CRITFC. About 9% of the sample was 5-year old fish with the remaining 3% being jack salmon (3-yr old) fish. The Bonneville count of 14,172 spring chinook (jack) salmon was about 3-times greater than the 10-year average. The return of jack salmon should lead to another near record return in 2002; the

Technical Advisory Committee is already projecting the upriver run (Bonneville Dam and above) to exceed 330,000. Figure 46 illustrates the huge increase of adult spring chinook in 2000 and 2001 after record low numbers of less than 40,000 fish in 1998 and 1999.

Approximately 77.3% of the fish passing Bonneville were counted at The Dalles Dam this year. The Wind, Klickitat, Little and Big White Salmon, and Hood rivers all support spring chinook via hatchery programs or programs to establish "natural" runs in these Basins. A limited commercial Tribal fishery on adult spring chinook was allowed as well as a sport fishery in the tributaries this season.

About 56.6% of the spring chinook counted at The Dalles Dam migrated to the Snake River. This percentage was much higher than the 2000 and 1999 returns to the Snake River basin. The fish count at Lower Granite Dam was 171,958, about 4.3 times greater than the next highest count since 1975. Estimated hatchery chinook at Lower Granite Dam comprised a minimum of 76% of the run (note that this percentage is based only on the absence of the adipose fin). The unclipped fish are considered to be "wild" or "natural" fish. In some cases a poorly clipped fin or missed clipping of a fin can lead to the mis-identification of a hatchery fish as a wild fish. The spring chinook count in the Snake River was at the all-time low of about 1,500 as recent as 1995, but rose to the all-time high record return of adult spring chinook in 2001. The number of "jack" spring chinook salmon that returned to the Snake River reduced to near 3,000, about 1/3 the 2000 return, but still 175% of the 10-year average.

The spring chinook count at Priest Rapids Dam was 50,379 with almost 40,000 arriving at Rock Island Dam. The 2001 count was about 2.6 times and 5.3 times greater than the respective 2000 and 10-year average adult spring chinook count at both projects. The Yakama River had an adult return of near 21,500 for the 2001 migration. Most spring chinook returning to the Mid-Columbia River are hatchery reared fish; with the exception of the Yakama River. In the Mid-Columbia, not all hatchery spring chinook are fin clipped to signify being of hatchery origin and no hatchery/wild adult return estimates were made from the fish counts. Numbers of "wild" chinook in the tributaries located above Rock Island Dam are still at extremely low levels.

Spring chinook "jack" salmon count at Priest Rapids Dam was 987, about 90% of the 2000 "jack" returns and 3.4 times greater than the 10-year average. Expected return of adult salmon to the upper Columbia River in 2002 should be near 51,000 plus another 21,800 for the Yakama River basin based on TAC estimates.

2. Summer Chinook

The summer chinook count at Bonneville Dam was 76,156, about 2.5 and 3.6 times greater than the respective 2000 and 10-year average. The summer chinook count at McNary Dam reduced to 67,914, about 89% of the Bonneville Dam count (Note: There is no summer chinook spawning between Bonneville and McNary dams.

About 15,300 adult summer chinook were counted at Ice Harbor Dam with near 14,000 passing Lower Granite Dam in 2001. The summer chinook count at Lower Granite was about 3.5 times greater than the 2000 and 10-year average. Snake River summer chinook are mainly destined for the South Fork of the Salmon River and its tributaries and Pahsimeroi River. This year's count of summer chinook "jacks" also was near 3,800 at Lower Granite Dam, almost identical to the 2000 total, but 4.4 times greater than the 10-year average at the project. The 2002 forecast by TAC is estimated to be near 17,000 adult summer chinook for the Snake River.

The Mid-Columbia count of adult summer chinook was 53,170, a total about 2.4 and 3.6 times greater than the respective 2000 and 10-year average. The passage of summer chinook at Rock Island Dam was 48,844 with 39,174 recorded at Rocky Reach Dam. Summer chinook destined for the Wenatchee River basin comprised about 20% of the returning adults, with the remaining 80% passing upstream of Rocky Reach Dam. Summer chinook can be either trapped at Wells Dam or volitionally enter Wells Hatchery for their hatchery program. As occurred in previous years, the return of "jack" summer chinook counted at Priest Rapids Dam was far less, about 24.5% of the jack count at Rock Island Dam and 58% of the Rocky Reach count. Overall, highly variable counts of “jack” summer chinook at Mid-Columbia projects are occurring this season as well as in previous years (See 2000 and 10-year average).

3. Fall Chinook

The number of fall chinook counted at Bonneville Dam was 400,410 with an additional 74,503 jack chinook salmon also counted. The 2001 adult count was double the 2000 and 10-year average counts, while the jack count was 1.3 and 2.3 times greater than the respective 2000 and 10-year average. The number of adult fall chinook (Bright component) that arrived at McNary Dam was near 110,500 (Figure 47), and exceeded the year 2000 and 10-year average. Most fall chinook passing McNary Dam are "wild" origin and generally destined for the Hanford Reach to spawn. Numbers counted at Rock Island and upstream dams have been increasing during the past few years as noted when compared to the 10-year average.

Tule fall chinook estimated from the fish counts at Bonneville Dam totaled near 128,000 with 48,702 adult chinook arriving at Spring Creek NFH, located in the Bonneville Dam pool (Figure 48). The number of Tule jack chinook rebounded from a near record low of 261 in 1999 to 12,037, a record high total returning to Spring Creek NFH.

The turn-off into the Snake River of 13,381 adult fall chinook was double the 2000 total; and the 10,000 jack salmon that returned was near equal the 2000 count but was 3.9 times greater than the 10-year average. Passage of adult fall chinook at Lower Granite Dam was 2.3 and 5.1 times greater than the respective 2000 and 10-year average.

4. Sockeye Salmon

The number of sockeye salmon returning to Bonneville Dam was 114,934 for the season. The bulk of sockeye in the Columbia River are destined for the Mid-Columbia River with approximately 71% destined for Lake Osoyoos and 29% destined for Lake Wenatchee in 2001. This year's return was greater than the 2000 count and about 2.5 times greater than the 10-year average.

Sockeye salmon recovery efforts in the upper Salmon basin continued with captive brood stock, habitat and other enhancement efforts in Red Fish, Alturas, and Pettit Lakes. In 2001, 36 adult sockeye were counted at Lower Granite Dam.

5. Coho Salmon

The combined return of adult and jack count of coho salmon in 2001 was about 260,000, triple the 2000 return, and 7.7 times greater than the 10-year average at Bonneville Dam. The count of coho was a record-high total over Bonneville Dam, partly due to release of additional juvenile fish into river basins above Bonneville Dam. The majority of coho passing Bonneville Dam still "home" into rivers and hatcheries located in the Bonneville pool. About 43,300 adult coho were counted at John Day Dam; most are destined for either the Umatilla River or the Yakama River. About 20,000 adult coho passed McNary Dam with most expected to enter the Yakama River. Based on fish counts at Rock Island and Rocky Reach dams, about 5,000 adult/ jack coho may have returned to the Wenatchee River. A small number of coho entered the Snake River basin and are part of on-going efforts to establish coho again in the upper basins.

6. Steelhead

The count of steelhead at Bonneville Dam totaled 633,464 and exceeded all counts recorded at Bonneville Dam since 1938. The count at The Dalles Dam was 503,327, John Day reported 483,409, and McNary Dam was 398,784.

The count at Ice Harbor Dam was 255,726 with Lower Granite reporting 262,558. The Snake River steelhead count at Lower Granite Dam was about 250% and 353% of the respective 2000 and 10-year average. Adult returns of steelhead to the Snake River are comprised mainly of hatchery-reared fish and support a sport fishery while the "wild" steelhead remain depressed and are listed as "Threatened" under the ESA. Numbers of "wild" steelhead increased to about 47,700 at Lower Granite in 2001.

The Mid-Columbia count of steelhead at Priest Rapids Dam was about 29,700, 258% and 335% of the respective 2000 and 10-year average. About 27,900 steelhead were counted at Rock Island with 18,500 above Wells Dam. Wild steelhead and Wells stock hatchery steelhead in the upper Mid-Columbia River remain depressed and are listed as "Threatened" under the ESA.

TABLE 45. Adult Salmonid Totals.

Cumulative Adult Passage at Mainstem Dams Through: 12/31/01

	Spring Chinook						Summer Chinook						Fall Chinook					
	2001		2000		10-Yr Avg.		2001		2000		10-Yr Avg.		2001		2000		10-Yr Avg.	
DAM	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack
BON	391,367	14,172	178,302	21,259	70,775	4,654	76,156	14,723	30,616	13,554	21,085	3,689	400,170	74,486	192,234	55,187	176,945	31,196
TDA	302,372	9,953	102,953	14,796	41,161	3,200	71,462	10,926	25,147	10,433	16,934	2,708	181,316	51,765	124,579	37,698	100,992	21,616
JDA	262,221	6,181	86,553	12,157	33,812	2,643	64,186	10,049	23,023	8,113	15,922	2,287	124,747	41,620	102,469	36,505	78,265	17,030
MCN	258,689	6,683	64,647	10,836	30,645	2,566	67,914	9,600	20,544	7,152	16,193	2,237	110,517	36,381	67,181	20,012	65,376	16,382
IHR	171,173	3,026	38,807	9,489	16,921	1,647	15,270	2,397	4,241	3,179	4,326	762	13,516	10,170	6,431	9,703	3,999	2,491
LMN	180,787	1,784	35,520	10,336	15,613	1,755	19,287	1,612	4,680	3,277	4,108	777	13,297	8,512	5,388	9,548	2,948	2,236
LGS	174,823	2,990	34,330	10,152	14,769	1,744	15,929	2,803	4,204	3,788	3,944	847	10,550	7,275	3,473	6,500	1,852	1,353
LWG	171,958	3,136	33,822	10,318	13,830	1,676	13,735	3,804	3,939	3,756	4,106	857	8,919	8,830	3,576	6,676	1,550	1,207
PRD	50,379	987	20,098	1,092	9,843	292	53,170	3,207	22,306	2,504	14,742	806	24,288	6,559	37,768	6,271	13,960	2,413
RIS	39,785	1,761	14,850	1,558	7,292	362	48,844	13,086	20,251	12,056	12,475	2,102	13,357	6,294	8,247	2,939	4,589	1,717
RRH	15,895	543	5,336	392	1,847	90	39,174	5,548	14,633	4,198	6,239	868	9,072	3,956	5,029	1,339	2,908	1,052
WEL	9,989	892	2,130	457	869	97	33,244	4,882	6,447	3,709	3,571	703	6,928	2,672	2,019	1,195	1,102	399

	Coho						Sockeye			Steelhead			
	2001		2000		10-Yr Avg.				10-Yr			10-Yr	Wild
DAM	Adult	Jack	Adult	Jack	Adult	Jack	2001	2000	Avg.	2001	2000	Avg.	2001
BON	259,520	6,787	83,738	11,160	31,265	3,773	114,946	93,398	46,485	633,065	274,682	226,178	149,317
TDA	62,378	2,179	24,860	4,500	7,467	1,221	102,562	73,383	36,197	503,327	204,504	160,634	125,120
JDA	48,870	2,311	20,356	3,364	6,075	1,061	107,869	88,372	38,896	483,409	218,434	148,958	112,335
MCN	22,919	1,812	11,023	995	2,933	404	97,188	60,242	37,157	398,784	128,537	119,509	94,384
IHR	1,286	74	885	194	109	20	28	216	31	255,726	117,551	94,316	46,258
LMN	797	159	535	160	63	17	32	291	37	252,843	110,228	84,216	45,689
LGS	490	50	278	0	40	0	74	296	42	232,669	98,755	72,879	44,150
LWG	925	110	741	31	99	5	36	299	37	262,407	104,656	74,341	47,711
PRD	10,144	1,045	335	37	46	4	111,320	89,547	44,813	29,675	11,168	8,559	**
RIS	10,465	0	1,605	0	171	0	104,847	76,515	39,214	28,602	10,410	7,326	16,252
RRH	1,628	0	520	0	59	0	66,222	57,428	23,367	22,027	8,147	5,084	10,664
WEL	609	7	0	0	16	2	74,490	59,944	22,414	18,483	6,121	3,885	8,381

**PRD is not reporting Wild Steelhead numbers.
These numbers were collected from the COE's Running Sums text files.
Wild steelhead numbers are included in the total.
Historic counts (pre-1996) were obtained from CRITFC and compiled by the FPC.
Historic counts 1997 to present were obtained from the Corps of Engineers.

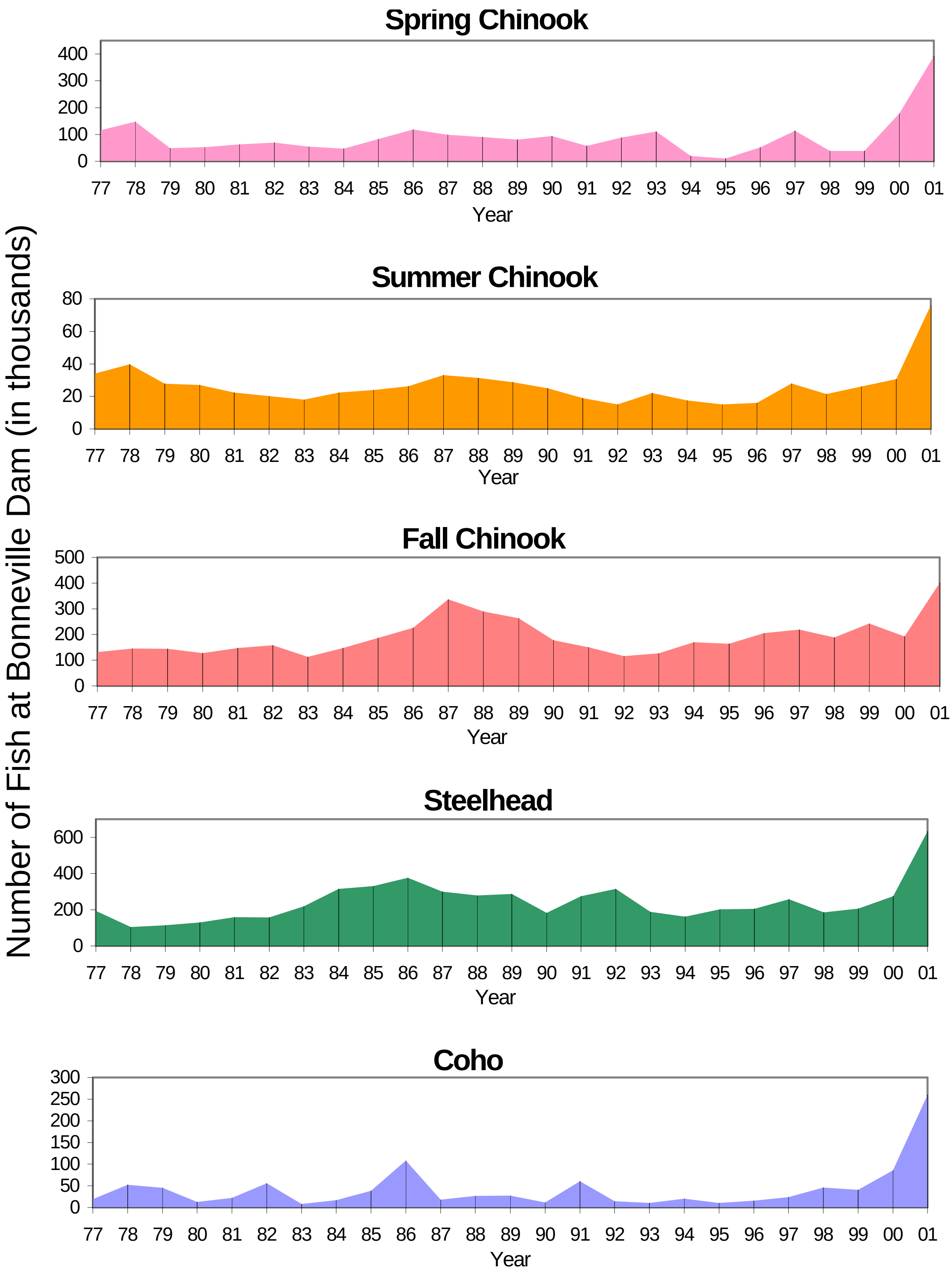

FIGURE 46. Adult Counts at Bonneville Dam, through 2001.

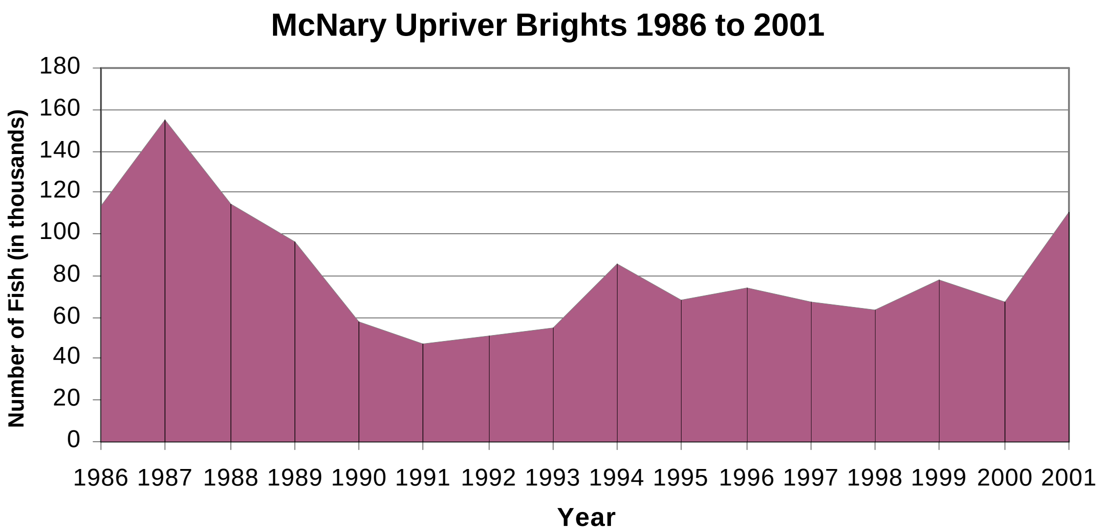

FIGURE 47. Upriver bright Fall Chinook passage at McNary Dam, 1986 to 2001.

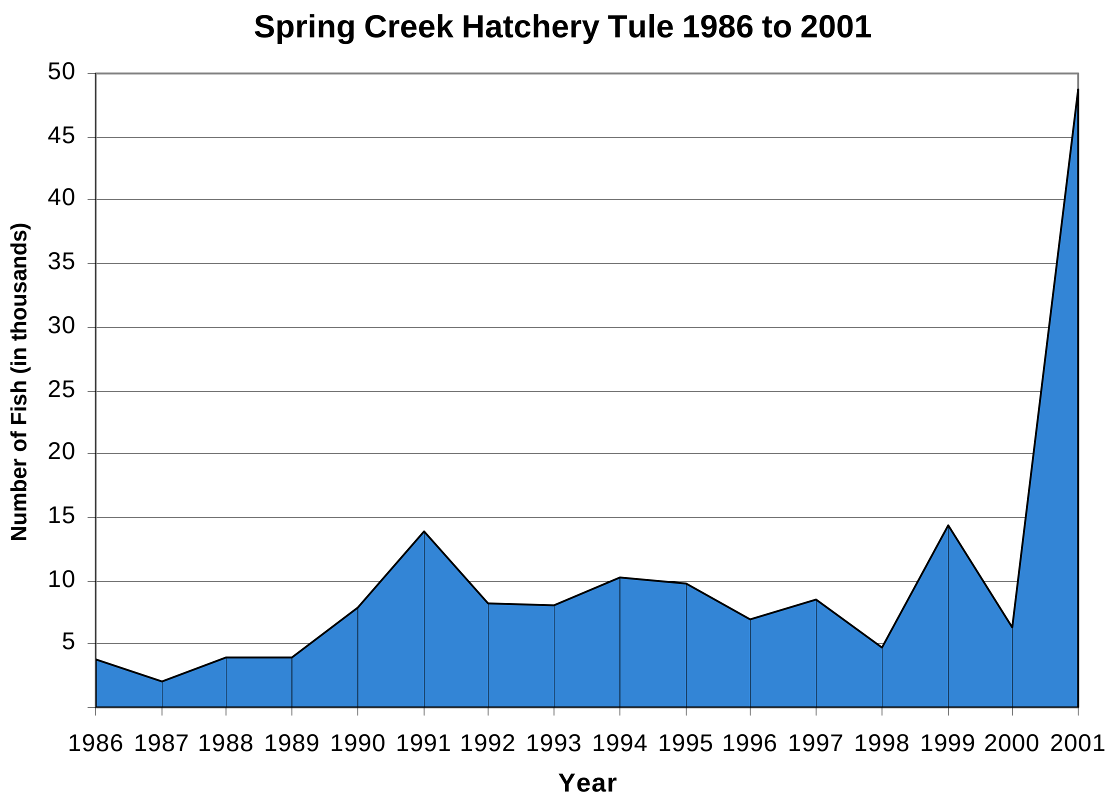

FIGURE 48. Tule Fall Chinook returns to Spring Creek Hatchery, 1986 to 2001.

V. Columbia River Basin Hatchery Releases

A. Overview

The FPC maintains a hatchery database of anadromous salmon species released from State, Federal, and Tribal hatcheries for archived numbers, from 1979 to the present year, 2001. The FPC receives preliminary hatchery release schedules that are updated through the year until the release numbers are "finalized" by the State, Federal, and Tribal fish agencies. Proposed hatchery releases are generally updated on a weekly basis during the spring and summer season to assure that the Salmon Managers will have accurate information relating to the migration of juvenile fish from Columbia River hatcheries upstream of Bonneville Dam.

The FPC hatchery release schedules do not include eggs that might be placed in egg boxes or planted in the gravel of Columbia River streams. Fry plants (not fall chinook fry) are included in the release schedules but will usually be listed as migrating the following year. The fry release totals are not normally calculated in the annual total for that year. Also fish that were determined to be non anadromous by the fish managers are not included in the FPC hatchery release schedule (an example would be subyearling summer chinook released in Lake Chelan; these fish normally do not migrate from the lake).

In 2001, about 71 million juvenile salmon were released from Federal, State, Tribal or private hatcheries into the Columbia River Basin above Bonneville Dam. Table 46 gives hatchery release totals by River zone, Snake River, Mid-Columbia, and Lower Columbia. The 2001 hatchery release totals were reduced about 14.5% from the previous season.

TABLE 46. Summary of Hatchery Releases by Species and Release Area for 2001.

Species	Snake River	Mid-Columbia	Lower Columbia	Total
Spring Chinook	2,801,410	3,258,547	5,853,807	11,913,764
Summer Chinook	1,343,943	4,324,169	0	5,668,112
Fall Chinook "Brights"	2,536,218	11,976,344	6,835,818	21,348,380
Fall Chinook "Tules"	0	0	10,569,810	10,569,810
Coho	597,192	2,151,318	6,762,367	9,510,877
Sockeye	86,017	241,216	0	327,233
Steelhead	9,796,039	1,291,813	603,293	11,691,145
TOTAL	17,160,819	23,243,407	30,625,095	71,029,321

The 2001 Hatchery Release Schedule (Appendix H) lists the agency, hatchery, release numbers along with other pertinent data such as mark groups, number per pound, date of release, release site, and river zone. The Year 2001 Release Schedule can be accessed at the FPC Website Home Page under Hatchery Data, and then Query Current and Historic Hatchery Database (1979-2002). Table 47, Table 48, and Table 49 list the hatchery release totals from 1980 through 2001 for the Snake, Mid-Columbia, and Lower Columbia Rivers respectively.

The primary factors affecting the 2001 hatchery release numbers were:

1. Hatchery spring chinook released in 2001 decreased by 3.3 million.
2. Tule fall chinook released from Spring Creek NFH totaled 10.6 million about 5.0 million below normal production for the facility and the upriver bright fall chinook numbers were also decreased by 3.7 million.
3. Coho production was reduced about 1 million from the previous year.
4. The only substantial gain in release numbers by species was the 1.6 million increase in production releases of hatchery summer chinook in the combined Snake and Mid-Columbia rivers.

B. Lower Columbia River

The Lower Columbia River is designated as the Reach from above Bonneville Dam to McNary Dam. This Reach accounted for approximately 43.1% of the fish released above Bonneville Dam in 2001. The release total of 30.6 million was less than in normal years mainly due to the reduced total of tule fall chinook liberated from Spring Creek National Fish Hatchery. Overall, 56.8% or 17.4 million of the 30 million hatchery fish released in this River Zone were yearling or subyearling upriver Bright fall or subyearling chinook stocks (Table 47).

About 10.6 million Tule fall chinook were released from Spring Creek NFH about 5 million below the normal production goal for the hatchery. The Bonneville pool remains the only area that Tule fall chinook are present above Bonneville Dam. No unfed fry were released from Spring Creek NFH (excess are normally released in mid-December). About 6.8 million Bright fall chinook were released in the Klickitat, Little White Salmon, and Umatilla rivers, a decrease from the previous year. Yearling releases continue to comprise a small portion of the total release; most are subyearling fall chinook released during the late spring and early summer time frame. This year's total of 17.4 million fall chinook was the lowest listed in the FPC database since 1979.

The total number of yearling and subyearling spring chinook released from Lower Columbia River hatcheries was 5.85 million, about equal to the previous two-year release totals. (Table 47). The 2001 spring chinook production in this Reach was greater than in either the Snake River or Mid-Columbia Reach. Subyearling spring chinook (580,000) were released in the upper Klickitat River and Big White Salmon rivers in May. Yearling spring chinook (about 5.3 million) were released in the Wind, Klickitat, Little White Salmon, Hood, Umatilla, and Deschutes rivers from late March to May.

The number of coho salmon released in 2001 in the lower Columbia Reach was about 6.8 million, a decrease from the 2000 total, but close to the previous 5 years that ranged between 6.7 and 8.0 million fish. Hatchery reared coho (both Type-S and Type-N) were released in the Klickitat, Little White Salmon, and Umatilla rivers. Hatcheries located below Bonneville Dam supply a large portion of the coho planted in the Klickitat and Umatilla rivers.

Both summer and winter race steelhead are released in this Reach, with 15-Mile Creek (just below The Dalles Dam) being the upper boundary for the Winter-run steelhead. The number of steelhead (summer and winter races) released in 2001 was about 603,000, and falls within the range recorded in this Reach since 1991 (583,000 to 689,000). Since 1980, steelhead releases have averaged about 630,000 per year. Winter steelhead releases totaled about 75,000 for the year, similar to the previous 2-years. Winter steelhead were released in Hood and Big White Salmon rivers. About 528,000 summer steelhead were stocked in the Klickitat, Hood, Deschutes, and

Umatilla rivers. The John Day River remains a "wild" stream with no steelhead or chinook released in that River basin. No hatchery steelhead have been released in the Wind River since 1998. Hatcheries located below Bonneville Dam, Skamania [WDFW], and Oak Springs [ODFW]) supplied Winter Run steelhead and some Summer Run steelhead released in this Reach.

TABLE 47. Lower Columbia Hatchery Releases, 1979-2001.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	3,491,500	110,500	40,975,000	456,500	3,288,000	0	48,321,500
1980	5,806,000	0	31,896,000	819,000	5,495,500	0	44,016,500
1981	6,066,500	0	35,936,500	609,500	4,391,500	0	47,004,000
1982	4,692,500	0	28,093,500	746,000	4,412,500	0	37,944,500
1983	6,003,500	0	34,141,500	631,000	4,912,500	0	45,688,500
1984	6,529,645	0	24,256,048	777,125	4,984,334	0	36,547,152
1985	6,344,905	0	20,804,201	744,290	2,162,846	0	30,056,242
1986	7,234,772	0	19,245,721	588,905	6,736,127	64,384	33,869,909
1987	6,099,130	0	18,149,291	404,000	9,292,000	0	34,002,428
1988	7,628,500	0	20,147,500	447,000	8,690,000	0	36,913,000
1989	8,891,430	0	24,805,762	555,526	8,451,762	0	42,709,616
1990	11,977,052	0	19,347,320	513,171	8,579,511	0	40,417,054
1991	9,046,069	0	27,266,266	583,156	8,467,969	0	45,363,460
1992	8,406,011	0	32,907,850	651,066	6,405,391	0	48,370,318
1993	7,435,146	0	30,927,448	689,196	8,954,465	0	48,006,255
1994	8,204,213	0	27,950,458	652,320	6,299,002	0	43,105,993
1995	6,939,030	0	24,858,274	587,171	6,712,604	0	39,097,079
1996	4,387,575	0	26,442,513	676,167	8,021,423	0	39,527,678
1997	4,093,528	0	23,233,638	688,909	6,763,470	0	34,779,545
1998	8,191,856	0	31,805,034	681,591	7,254,648	0	47,933,129
1999	5,488,404	0	19,322,806	621,079	7,186,404	0	32,618,693
2000	5,320,322	0	28,615,317	635,308	8,021,720	0	42,592,667
2001	5,853,807	0	17,405,628	603,293	6,762,367	0	30,625,095

C. Mid-Columbia River

The Mid-Columbia Reach or Zone encompasses the area from above McNary Dam to Chief Joseph Dam. In 2001, approximately 23.2 million juvenile salmonids were released in the Mid-Columbia, approximately one million more than the previous year and similar to the 1999 total (Table 48). Releases of juvenile chinook, sockeye, and steelhead in this Reach have been fairly stable since 1995, with numbers of juvenile spring chinook expected to increase slightly in the next few years. The release of juvenile hatchery summer chinook and coho salmon established new highs in the FPC database with more than 4.3 and 2.2 million released in 2001, respectively.

Production releases of juvenile fall chinook (up-river Bright stock) totaled 12.0 million, similar to the past 5 years where totals ranged between 11.9 and 12.4 million released per year. Of the 2001 release, 6.9 million subyearling fall chinook were released from the Priest Rapids Hatchery, and the remainder were released in the Yakima River basin and the mainstem Columbia River from Ringold Hatchery. Yearling fall chinook were not released in the Mid-Columbia Reach in 2001. Hatchery fall chinook comprised about 51.5% of the total fish released in this Zone.

About 4.3 million summer chinook salmon were released from hatcheries, acclimation ponds, or into Mid-Columbia streams and tributaries located above Rock Island Dam. Summer chinook are predominately reared in the hatcheries until yearling age (about 18 months) and released during the spring. The subyearling releases (about 1.6 million) were completed in June/July and normally migrate through the Mid and Lower Columbia rivers in June, July, and August. Summer chinook were released in the Wenatchee, Similkameen, Methow, and the mainstem Columbia River from Wells and Turtle Rock hatcheries. From 1979 through 1994, releases averaged about 2.1 million summer chinook per year. From 1995 to present, releases have increased and now range between 2.8 and 4.3 million per year.

Mid-Columbia hatcheries released about 3.3 million yearling spring chinook over 2001, a reduction of about 0.6 million from 2000. Differences in releases between 2000 and 2001 can be explained by reduced production from several hatcheries, and non-production of spring chinook at Ringold State Hatchery. All returning adult fish to Ringold Hatchery were transported for release into the South Fork Walla Walla River or other designated sites. Yearling spring chinook were released in the Methow, Entiat, and Wenatchee Rivers and tributaries with nearly 500,000 volitionally released from Acclimation facilities in the Yakama River basin (Easton Pond, Jack Creek and Clark Flat). Hatchery releases of spring chinook averaged about 4.8 million from 1980 to 2000. Release totals have been reduced since 1993 with only 2 of the 8 years reaching the 4.8 million average. Hatchery spring chinook releases are predicted to increase over the next few years; however, may not maintain the past high levels with the reduced production from the Ringold Hatchery.

Coho salmon production released from acclimation ponds and hatcheries was about 2.2 million for the Mid-Columbia Reach, with 888,000 released in the Yakima River Basin and 0.86 and 0.41 million released in the Wenatchee and Methow rivers, respectively. All coho released in this Reach are transferred from hatcheries below Bonneville Dam or from Willard Hatchery (Bonneville Pool) to acclimation pond(s) or hatcheries and held until liberated from the rearing pond or raceway. The 2001 release of yearling coho in the Mid-Columbia Reach was a new annual high. All coho released in the Mid-Columbia are part of the Yakama Tribal Program to reestablish coho runs in the Yakama, Methow, and Wenatchee River basins.

For the Mid-Columbia Reach, 241,246 yearling sockeye salmon were released for the 2001 Migration Year. About 168,000 yearling sockeye from the net pens located in Lake Wenatchee and 73,300 sockeye from Lake Osoyoos were released from late August to November 1, 2000 with the bulk of fish expected to migrate from the lakes in spring of 2001. The Wenatchee sockeye were 100% ad clipped with Coded Wire Tags (CWTs) while the Osoyoos stock sockeye were 100% RV clipped with no CWTs. Hatchery production of both stocks was increased for the 2001 migration. The Osoyoos Program will release sockeye this fall, 2001, then sockeye production will be terminated in the Okanogan River basin.

Since 1992, hatchery production of juvenile steelhead has averaged about 1.4 million per year in the Mid-Columbia Reach, with 2001 releases at 1.3 million. About 244,000 juvenile steelhead were released in the Walla Walla River basin with the remainder in the Okanogan, Methow, Entiat, and Wenatchee Rivers and tributaries as well as the mainstem release from Ringold Hatchery. As noted in previous years, hatchery steelhead (Wells stock) are listed as Threatened under the ESA. Hatchery steelhead have not been released in the Yakama River for several years. Hatchery steelhead production has been very stable in this Reach through the past 20 years.

TABLE 48. Mid-Columbia Hatchery Releases, 1979-2001.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	3,509,000	2,501,000	826,500	592,500	640,000	0	8,069,000
1980	4,788,000	2,638,000	3,327,500	873,000	1,206,500	0	12,833,000
1981	5,161,000	2,271,500	5,115,500	985,000	1,089,500	0	14,622,500
1982	5,186,500	3,010,500	6,297,500	1,263,500	482,500	0	16,240,500
1983	4,369,000	1,609,000	10,276,500	1,471,500	536,000	0	18,262,000
1984	6,492,744	1,240,865	15,548,324	1,587,329	517,100	0	25,386,362
1985	4,796,554	1,630,322	10,789,141	1,345,923	389,005	64,031	19,016,813
1986	4,651,848	1,992,057	10,402,956	1,504,450	556,017	64,926	19,259,428
1987	4,585,223	1,413,000	8,606,441	1,748,868	911,500	25,000	17,308,132
1988	6,034,795	2,144,500	9,769,500	2,167,000	1,329,500	47,500	21,492,795
1989	4,565,017	2,597,099	7,571,364	1,810,287	1,084,753	107,299	17,735,819
1990	8,800,002	1,912,708	9,339,478	1,822,491	1,118,138	91,999	23,084,816
1991	6,455,727	2,258,293	7,195,765	1,913,905	1,126,683	616,038	19,566,411
1992	5,250,389	2,551,616	7,216,100	1,382,511	1,246,195	107,052	17,753,863
1993	4,305,286	1,800,199	8,862,582	1,368,682	1,167,694	354,595	17,859,038
1994	3,803,697	2,097,319	14,162,311	1,440,117	857,783	428,200	22,789,427
1995	5,076,896	2,760,748	14,399,490	1,414,719	666,862	40,963	24,359,678
1996	3,243,054	3,889,547	12,422,257	1,411,096	1,680,209	150,000	22,796,163
1997	1,328,576	3,403,136	12,407,097	1,420,394	1,124,821	339,158	20,023,182
1998	3,328,869	3,537,781	11,924,206	1,472,296	1,739,476	365,784	22,368,412
1999	4,956,745	2,977,364	11,870,800	1,726,741	1,486,500	210,591	23,228,741
2000	3,939,920	2,853,950	12,293,934	1,396,898	1,662,994	142,901	22,290,597
2001	3,258,547	4,324,169	11,976,344	1,291,813	2,151,318	241,216	23,243,407

D. Snake River

The total release of all species of salmon in the Snake River basin was 17.2 million for the 2001 migration season, about 3.8 million less than the preceding year (Table 49). Basically, the reduction of fish released in this Zone was the shortfall of juvenile spring chinook salmon released from IDFG, ODFW, USFWS, and WDFW hatcheries. Fall chinook production also declined from the previous year, but overall, fall chinook numbers appear to be increasing. The 2001 production from hatcheries and acclimation facilities are still rebuilding numbers of spring chinook salmon after the all-time low production in 1996 and 1997.

The 2001 production release of hatchery spring chinook in the Snake River basin totaled about 2.8 million, the 3rd lowest on the FPC database since 1979. Yearling spring chinook were released in the Clearwater, Grande Ronde, Salmon, Tucannon, and Imnaha River basins from hatcheries or acclimation ponds during the spring season. Most spring/summer chinook were adipose or ventral fin clipped; however, not all hatchery fish were marked in 2001. A portion of the hatchery production of spring chinook from IDFG and ODFW hatcheries are classified as "listed" under the ESA. Captive brood stock releases of juvenile salmon are now occurring at some of these hatcheries. As noted, production releases of yearling spring chinook were extremely reduced in 2001; however, the 2001 release of 2.8 million compares to the 1997 release of only 478,000. This year's total showed a 586% increase from the 1997 release, before there was some improvement from the 4-year brood cycle.

About 1.34 million juvenile summer chinook were released from McCall and Pahsimeroi hatcheries in 2001, a small increase from the 2000 release total. The 2001 release groups were well above the low production totals experienced from 1996 to 1998. A portion of the hatchery summer chinook from McCall Hatchery is listed as “Threatened” under the ESA. Yearling-age summer chinook from McCall Hatchery are annually trucked to and released at Knox Bridge located on the S. Fork Salmon River. Supplemental releases of summer chinook were also completed from the Stolle Meadow Pond during the past few years.

Hatchery production of Snake River fall chinook was reduced from the previous year but 2.5 million were released in 2001 in the Snake River with another 200,000 subyearling fish released directly from the barge at a release site below Bonneville Dam. Note that these 200,000 are accounted for in the Below Bonneville Zone Report. Approximately 658,000 yearling chinook were released from Lyons Ferry Hatchery and acclimation facilities at Pittsburg Landing and Captain Johns on the Snake River and Big Canyon Creek on the Clearwater River. Subyearling fall chinook were released from Captain Johns, Big Canyon and Pittsburg Landing acclimation facilities. Yearling releases were completed in April with the subyearling chinook released in late May and June. A portion of the subyearling chinook released from the acclimation sites were unmarked. Distinguishing "Hatchery from Wild" chinook was not possible as juvenile migrants, and will continue to be difficult to ascertain when these fish return as adults in future years.

Production releases of yearling sockeye into Red Fish, Alturas, and Pettit Lakes and Red Fish Lake Creek totaled 86,017, about double the 2000 release total. Releases occurred during the fall (2000) and spring 2001. All sockeye were 100% marked with adipose fin clips and a small number of the fish were PIT tagged. Efforts continue to allow adult sockeye to establish a natural spawning base in the Lake system to complement the hatchery-reared fish released as juvenile migrants each year.

About 597,200 yearling coho salmon were released in the Clearwater River basin in 2001. This year's release total was reduced from the 1999 and 2000 release groups. The reintroduction of coho into the Snake River Basin is expected to continue through upcoming years. Most production releases have been unmarked, i.e., released with no clipped fins. Adult coho salmon are now returning to these natal upstream sites and spawning.

Production of hatchery steelhead in the Snake River basin was similar to 2000 with 9.8 million released in 2001. From 1981 to present, steelhead production has ranged between 8.1 to 12.1 million with the 2001 release groups residing within this range. About 57.1% of the anadromous salmonids released from Snake River basin hatcheries were steelhead. B-Run steelhead were released in the Clearwater River basin as well as selected areas in the Salmon River Basin. A-Run steelhead were released in the Salmon, Grande Ronde, Imnaha, and Tucannon River Basins, and other tributaries of the Snake River. Most steelhead are released during the spring, late March through late-May and migrate through the River in April and May with the later fish migrating in June.

TABLE 49. Snake River Hatchery Releases, 1979-2001.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	5,641,500	236,500	0	4,064,000	0	0	9,942,000
1980	6,113,500	0	0	6,328,000	0	0	12,441,500
1981	4,778,000	249,500	0	8,602,500	0	0	13,630,000
1982	3,027,500	264,000	0	8,687,500	209,500	0	12,188,500
1983	5,393,500	198,500	79,000	8,921,500	0	0	14,592,500
1984	7,076,708	356,673	427,191	10,802,035	0	0	18,662,607
1985	8,084,943	781,405	1,317,921	9,419,904	0	210,000	19,814,173
1986	6,314,421	982,443	2,271,520	8,085,953	0	0	17,671,075
1987	10,743,364	1,217,000	1,060,500	8,242,200	0	0	21,601,064
1988	11,230,000	1,777,500	4,981,000	11,726,776	0	0	29,715,276
1989	10,446,274	1,991,300	2,153,882	9,146,283	0	0	23,737,739
1990	13,306,749	2,882,400	3,480,110	11,149,502	0	0	30,818,761
1991	8,908,172	936,100	224,660	12,068,104	0	0	22,137,036
1992	8,006,203	1,507,400	689,601	9,510,474	0	0	19,713,678
1993	4,046,446	982,300	966,793	10,302,377	0	0	16,297,916
1994	6,752,805	1,190,673	603,661	9,600,381	0	0	18,147,520
1995	8,557,388	2,095,143	374,882	10,109,372	0	30,973	21,167,758
1996	1,541,127	676,894	630,612	10,461,986	0	157,095	13,467,714
1997	478,096	360,603	1,137,678	9,959,153	0	1,926	11,937,456
1998	3,176,804	577,618	842,007	9,209,992	695,716	263,307	14,765,444
1999	9,309,857	1,574,369	1,834,739	9,840,622	788,358	151,899	23,499,844
2000	5,968,537	1,172,717	3,234,767	9,775,735	797,474	40,419	20,989,649
2001	2,801,410	1,343,943	2,536,218	9,796,039	597,192	86,017	17,160,819

APPENDIX A

Memorandums

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MEMORANDUM

TO: Michele DeHart

FROM: Tom Berggren

DATE: August 15, 2001

RE: Subyearling chinook migration in 2001

As per your request, I looked at some preliminary characteristics of the 2001 subyearling chinook migration. Subyearling chinook had its peak passage occur at McNary Dam during the first week of July in 2001, similar to the historic 12-year average. However, the peak was short lived, followed by second smaller peak in passage after Mid-July (Chart1). With the extremely low Snake River summer flows, complete transportation of Lyons Ferry Hatchery chinook from the facility to below Bonneville Dam this year, and the usual maximized transportation of subyearling chinook from the Snake River dams, the number of Snake River basin subyearling chinook expected to arrive McNary Dam was even smaller than in past years. Therefore, the subyearling passage timing at McNary Dam in 2001 is a reflection of Mid-Columbia River basin stocks. Even with the default return-to-river of PIT tagged wild and hatchery fall chinook at the Snake River dams, fewer than usual PIT tag detections of these fish were made at McNary Dam.

- The nearly 1,400 PIT tagged wild subyearling chinook in the Snake River had only 16 detections at McNary Dam in 2001.
- The timing of the Snake River wild subyearling chinook at McNary Dam was similar to that in 1995 and 1998, but was a much lower fraction of fish detected (Chart 2). The Snake River PIT tagged wild chinook arrived at McNary Dam during the second period of peak passage of the run-at-large.
- Median travel time of the wild subyearling chinook from Lower Granite Dam to McNary Dam was approximately 30 days; nearly double that of recent years except for 1997 (Chart 3).
- The percent of PIT tagged wild subyearling chinook detected at Lower Granite Dam through August 14, 2001, was 13% of the release number, much lower than the seasonal percentage in any of the past six years since the 95-Biop was adopted (Chart 4).

G:\STAFF\DOCUMENT\2001 Files\204-01.doc

- Few Snake River basin PIT tagged subyearling chinook, wild or hatchery, were detected at both McNary and Bonneville dams to date, so it is too early to compare travel time estimates. However, PIT tagging of large numbers of Priest Rapids Hatchery fall chinook for studies at Wanapum and Priest Rapids dams, as well as the regular on-site releases of subyearling chinook from Priest Rapids and Ringold hatcheries, have provided a sizeable number of fish for travel time evaluation in the lower Columbia River between McNary and Bonneville dams. The 2001 median travel time in this lower Columbia River reach has ranged around two-weeks for these mid-Columbia River fish. This is much lower than the approximate 5-day median 3-year aggregate (1997-99) of Snake River basin wild and hatchery fall chinook subyearlings in this same reach under much higher flows.

Median travel time McNary to Bonneville Dam for Mid-Columbia basin hatchery subyearling fall chinook in 2001.

Dates	Count	Median TT
6/16-22	66	14.3
6/23-27	148	16.2
6/28-7/4	172	14.9
7/5-7/16	32	13.5

CHART 1
Subyearling chinook timing at McNary in 2001 (through 8/14/01) versus 12-yr average

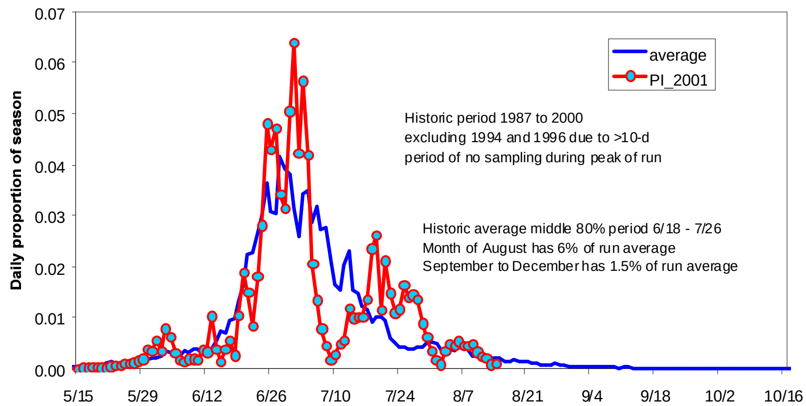


CHART 2
Snake R basin wild fall chinook passage timing at McNary Dam

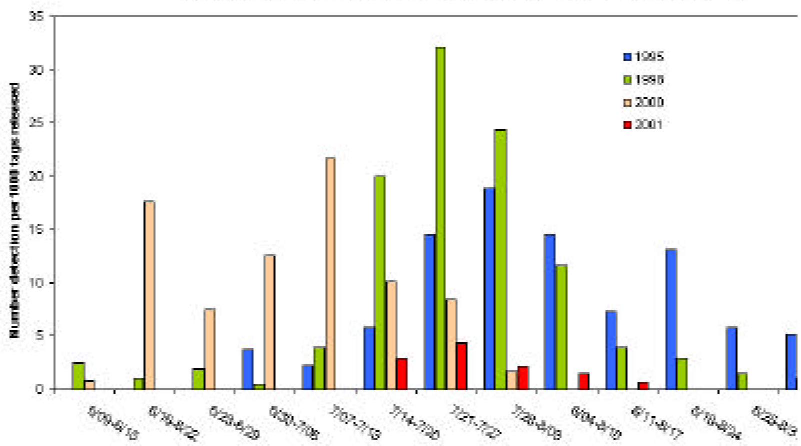


CHART 3
Median travel time between Lower Granite and McNary Dam of wild subyearling chinook passing Lower Granite Dam from June 15 to July 16

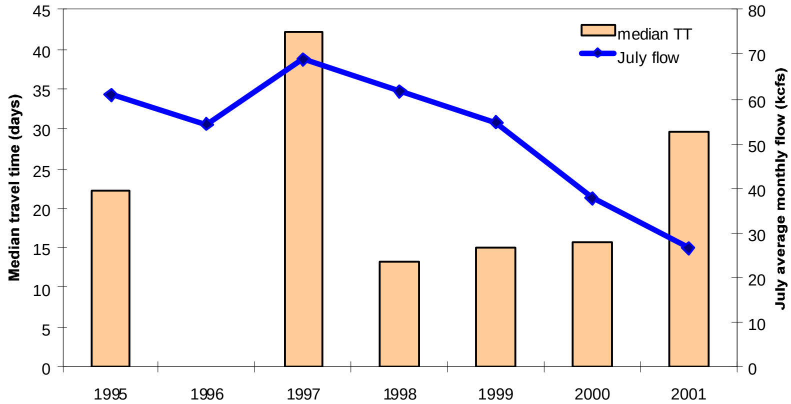
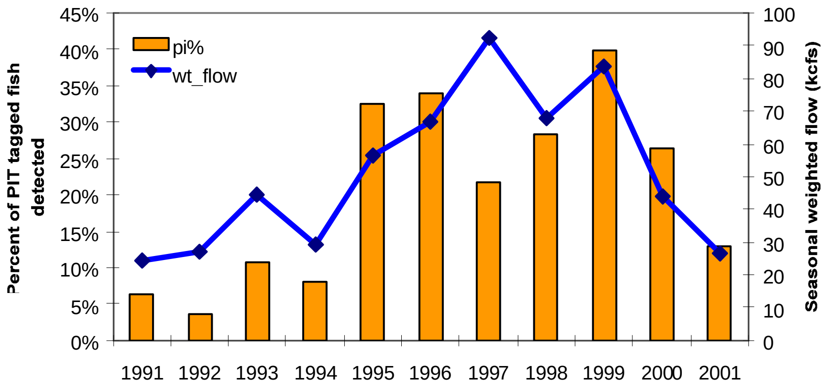


CHART 4
Percent of PIT tagged wild fall chinook detected at Lower Granite Dam versus passage index weighted seasonal flow



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MEMORANDUM

TO: Jim Ruff, NMFS
Doug Marker, NWPPC
FPC Board of Directors
FPAC

Michele DeHart

FROM: Michele DeHart

DATE: October 22, 2001

RE: FPC Preliminary Analysis 2001 Juvenile Out Migration

Attached is a written response to a data request we received from Jim Ruff, National Marine Fisheries Service on October 15, 2001. Jim had asked us to provide a written description of the FPC analysis of the portion of the presentation that dealt with spill at John Day Dam. That written documentation is attached. **Again as was stated in the previous presentations, the data analysis is preliminary, completed in response to specific requests by the fishery managers and tribes. The final analysis of the downstream migration for 2001 is, according to the FPC work statement, included in our final report. The data used in the analysis is available to the public through the PTAGIS data system.**

In addition, I have attached an article that appeared in the recent NW Fishletter about funding. That article included a reference to the Fish Passage Center analysis and included several misleading comments regarding the FPC presentation. Below are plain facts regarding the presentation by the FPC, which I hope will clear up the misinformation included in the NW Fishletter.

- The NMFS Implementation Team and the Columbia Basin Fish and Wildlife Authority requested that FPC present a preliminary analysis of the 2001 downstream migration. The FPC responded to both of those specific requests with the same presentation on October 4 and October 11, 2001. We did not receive any other requests for presentations.
- Both the NMFS, Implementation Team and the Columbia Basin Fish and Wildlife Authority requested that FPC specifically review Mid-Columbia and Lower Columbia River passage.
- The presentation clearly stated that the information was preliminary, and that it would be finalized according to our normal process in the 2001 Annual Report. It was clearly

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explained that the analysis was done using the consistent methodology and techniques described in each of our annual reports and implemented each year.

- On October 15, 2001 Jim Ruff requested a specific description of the spill analysis. I explained to Jim that the techniques and analysis would be included in our annual report. He asked for a specific write up describing our preliminary conclusions on spill at John Day, which we are providing to him and the public on October 22, 2001.
- Bruce Suzumoto, NWPPC telephoned on October 10, 2001 and asked FPC staff if a written analysis was available. The staff explained that we would have the final analysis in our annual report. The FPC staff also stated that, if the NWPPC had immediate needs, we would sit down with the NWPPC staff and go over the details of the analysis at their request at anytime. No such request was received from the NWPPC. In addition, no request for written analysis was received. We remain available to discuss the analysis at anytime.
- The NMFS Science Center staff did not request any details of analysis nor did they speak to anyone on the FPC staff about the presentation. They did not request any data that was the basis of the analysis. In fact the NMFS Science Center staff did not speak to anyone at the FPC about the analysis or about questions regarding the analysis.
- The NW Energy Newsletter staff, which wrote the article about the analysis, did not contact the FPC staff.
- The FPC presentation was posted on the FPC Web site on Monday, October 8, 2001.
- This memorandum and the spill analysis will be posted on the FPC Web site today, October 22, 2001.

As is always the case and in accord with our normal procedures the FPC staff is always available to respond to questions or comments. The FPC annual report is circulated in draft for a 45-day public review prior to being finalized.

Subject: funding story - N.W. Fishletter

SEPT. 11 EVENTS MAY AFFECT NEXT YEAR'S SALMON BUDGETS
http://www.newsdata.com/enernet/fishletter/fishltr132.html#4

With budget issues a main item on the agenda, the NW Power Planning Council's F&W committee played to a packed house the other day in Portland. BPA is still committed to spending $186 million on the Columbia Basin's F&W program, but Council members heard that other federal agencies may not have any money to pay for their share of the BiOp next year, due to shifts in priorities brought about by last month's terrorist attack on the World Trade Center. The Council is struggling with the BiOp itself, and working to integrate it into its new subbasin planning process.

A cameo appearance by the new NMFS regional administrator Bob Lohn, late of the Power Council staff, added to the draw. He hinted that NMFS may soon make some significant changes in how it handles the ESA and fish listings in response to a recent court decision that ruled against the agency.

"One signal I want to send clearly is in regard to how the Administration responds to the Hogan decision," Lohn said, referring to the Oregon federal judge's ruling that NMFS erred by not providing ESA protection for hatchery fish along with wild stocks of the same evolutionarily significant unit. "Subbasin planning is absolutely critical." He said that no one in the Administration "is comfortable with the idea that you can walk away from stocks in poor condition."

Lohn said there has been intense discussion in DC over the Hogan ruling and that it will go through a full set of ESA policy decision-making. "There's no final decision yet."

He told Council members that in a few weeks, their work would be seen to be very important. But Lohn wouldn't elaborate, leading to speculation that he was referring to the extensive effort, led by Council staff, to overhaul hatchery practices throughout the basin. More than one observer said the remark signaled a possible sea change in the way NMFS will rate hatchery stocks in ESA-listed fish populations. Whether that could lead to de-listing of some stocks is anybody's guess.

Council staffer Doug Marker, acting head of the NWPPC's fish and wildlife division, said Bush Administration priorities have shifted due to the Sept. 11 terrorist attacks. The five-year plan to implement the BiOp is on hold, he said, but the ongoing one-year implementation plan is still moving ahead.

Using the Bureau of Reclamation as an example, Marker said funding for irrigation screens and water rights to aid fish recovery in tributaries--items that also give the action agencies credit against the BiOp--may not be available because the agency may have to ask for money to safeguard its projects. But neither the Council nor BPA wants to be on the hook for all BiOp costs.

"The Council can play a central role in getting appropriations," Marker told the group, by lobbying for agency budgets. Federal agencies are not allowed to lobby Congress for their funds.

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Sarah McNary, BPA's own F&W head, was there to show support for the Council's subbasin planning process and discuss the 50 pages of comments her agency had sent the Council over funding F&W proposals. She called it "the beginning of a dialog" and stressed that BPA's comments do not mean that it's exclusively a BiOp-focused review. It's all part of a complicated effort to reach compliance with the BiOp, after input from NMFS on whether certain proposals get "credit" for implementing the plan to avoid jeopardy to fish stocks listed under the ESA.

The immediate issue is how to prioritize fish recovery proposals in the Columbia plateau region, where the Council's independent science panel and fish managers agreed on $66 million in projects for next year.

With no budget ceiling to work with originally, fish managers had come up with over $80 million in proposals before the scientific review. Last year, the plateau province budget amounted to only $28 million.

"BPA never gave us a number to work with," said Brian Allee, head of the Columbia Basin Fish and Wildlife Authority. He said CBFWA will now be going back to take another look at the budget with BPA.

Marker said the problem is how to allocate funding among the provinces still under review, since $41 million has already been committed to three regions. Though BPA has bumped total F&W spending from $159 million last year to $186 million, pro-rating the increase over the provinces still under review would add only about $8 million for the plateau province and bump spending for the area, which contains some of the program's spendiest hatchery projects, up to $35 million. That means cutting the current number of recommended proposals in half.

So the Council staff will lead the prioritization effort. The question, Marker said, is whether BPA will OK those recommendations, even if it didn't say yes the first time around, as with the so-called "early action" and "high priority" projects BPA decided to fund on its own.

A sleeper issue that made the agenda last week was the proposal to create a new oversight board to guide activities of the Fish Passage Center, long seen by power advocates and some others as an advocacy group when it was created to provide information on fish passage and make recommendations for flow and spill operations of the hydro system.

FPC staffer Margeret Filardo recently made headlines by announcing results of juvenile survival that showed benefits of spill during this year's migration, adding to earlier results announced in August (See *NW Fishletter* 129) . However, when pressed, the FPC was not able to produce documentation to explain the findings. In fact, NMFS scientists told *NW Fishletter* that they were unable to duplicate the FPC survival results and that sample sizes were so low that results from the spill survival analyses were "statistically insignificant."

That's exactly why some Council members have pushed for more oversight of the Fish Passage Center. When Council counsel John Shurts said he thought the FPC results should be presented to Council members along with the latest NMFS results, Montana's Stan Grace asked if the Fish Passage Center had any supporting documents besides the presentation that's available on its website. "They have not, I've been told," said Grace. Shurts said the staff was working on that. *-B. R.*

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MEMORANDUM

TO: Michele DeHart

FROM: Tom Berggren

DATE: October 22 2001

RE: Effect of spill at John Day Dam on yearling chinook and steelhead survival estimates from McNary Dam tailrace to John Day Dam tailrace in 2001.

This memorandum is in response to the October 15, 2001 request received from National Marine Fisheries Service to provide the details of the preliminary analysis of spill at John Day Dam, which was discussed in FPC presentations on October 4 and October 11, 2001.

Migration year 2001 was characterized by record low flows and power emergency operations in the Columbia Basin hydro system. The springtime spills provided by the NMFS' BiOp measures were curtailed at the COE operated dams for the entire season in the Snake River and for all but a few weeks at reduced levels, in the lower Columbia River.

In summary, the analysis showed:

- Increased juvenile salmonids survival was observed between McNary Dam tailrace and John Day Dam tailrace.
- The increase in survival was a result of spill.
- Spill duration in 2001 was too limited to protect all migrating stocks.

Lower Columbia River spill provision in 2001

For planning purposes, the NMFS Biological Opinion calls for springtime spill for fish passage to be provided between April 10 and June 30 at McNary, John Day, The Dalles, and Bonneville dams in the lower Columbia River. It also calls for summertime spill for fish passage between July 1 and August 31 at John Day, The Dalles, and Bonneville dams. In migration year 2001, a federally declared power emergency allowed BPA and the COE to operate outside the provisions of the NMFS Biological Opinion. As a result, springtime spill for fish passage in 2001 was provided only between May 25 and June 15 at McNary and John Day dams and between May 16 and June 15 at The Dalles and Bonneville dams. Summertime spill for fish passage in 2001 was provided only at The Dalles and Bonneville dams between July 24 and August 31. **This memorandum addresses the springtime migration and the effects of the**

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spill provided during that migration period because of our ability to estimate survival of smolts in the lower Columbia River only during that period.

Yearling chinook reach survival estimates from McNary Dam tailrace to Bonneville Dam tailrace in 2001

Significantly greater numbers of yearling chinook were available for study this year because of the survival studies conducted by the Mid Columbia PUDs. These fish were PIT tagged and released into the Mid Columbia River. Most PIT tagged yearling chinook and steelhead passed McNary Dam between May 1 and June 9 in 2001. During this time there were 138,205 PIT tagged yearling chinook and 5,328 PIT tagged steelhead detected at McNary Dam on a route that confirmed they were returned to the river. These fish were a composite of Mid Columbia and Snake River origin.

The PIT tagged yearling chinook were blocked into nine multi-day passage groups, spanning May 1-10, May 11-15, May 16-18, May 19-21, May 22-23, May 24-25, May 26-27, May 28-30, and May 31-June 9. The Cormack-Jolly-Seber (CJS) methodology was used with McNary Dam considered the release location and John Day Dam, Bonneville Dam, and the NMFS trawl in the Jones Beach section of the lower Columbia River as three recovery sites. Release numbers per block ranged between 11,883 and 25,778 and provided detection numbers in the trawl between 137 and 301 fish (average 220), large enough to provide survival estimates in the lowest reach between John Day Dam tailrace and Bonneville Dam tailrace with standard errors (c-hat adjusted) <0.14. The c-hat adjustment increases the CJS theoretical variance to compensate for over-dispersion in the data relative to the underlying multinomial model. The product of two reach survival estimates (McNary Dam tailrace to John Day Dam tailrace and John Day Dam tailrace to Bonneville Dam tailrace) produced the overall survival estimate from McNary Dam tailrace to Bonneville Dam tailrace. The estimates of these survival parameters are negatively correlated (i.e., if survival in the upstream reach is overestimated, then the survival in the downstream reach will be underestimated), and so the variance of S_1*S_2 was computed as $var(S_1*S_2)=(S_1*S_2)^2\{var(S_1)/(S_1)^2+var(S_2)/(S_2)^2+2cov(S_1,S_2)/(S_1*S_2)\}$. The computation used the identity $cov(S_1,S_2) = se(S_1)*se(S_2)*correlation(S_1,S_2)$. Both season unweighted and weighted averages are computed. A seasonal weighted average is generated using the inverse relative variance of each estimate as a weight, i.e., $w_j=1/(se(S_j))^2/S_j^2= S_j^2/(se(S_j))^2$.

Table 1. Yearling chinook survival estimate from McNary Dam tailrace to Bonneville Dam tailrace, 2001.

date range	S	se(S)
5/1-5/10	0.3978	0.0470
5/11-5/15	0.5477	0.0852
5/16-5/18	0.5069	0.0661
5/19-5/21	0.5261	0.0817
5/22-5/23	0.6437	0.0804
5/24-5/25	0.5969	0.0615
5/26-5/27	0.6755	0.0783
5/28-5/30	0.5690	0.0990
5/31-6/9	0.4830	0.1249
Weighted mean	0.5598	0.0309
Simple mean	0.5496	0.0282

Whenever the survival estimates of the groups released over time do not significantly differ, a single seasonal average is a logical summary statistic. However, if significant differences occur over time, then it is important to present these differences and investigate potential influencing factors. To determine if any significant differences occurred within a year, a test of whether the "between group" variance component was significantly greater than zero (Burnham 1987 *et al*., Chapter 4). This is a chi-square test equal to [empirical variance of mean survival*(1-degrees of freedom)]/ [theoretical variance of mean survival]. In cases where the chi-square test was not significant at the 95% confidence level, then the average was computed for the season; otherwise, the season was split into periods showing the different survival levels. The chi-square test result of 8.25 was not significant (less than the significance level of X^2[8 df, 0.05] = 15.51), and so temporal differences were not greater than what is expected by random chance.

Yearling chinook reach survival estimates from McNary Dam tailrace to John Day Dam tailrace in 2001

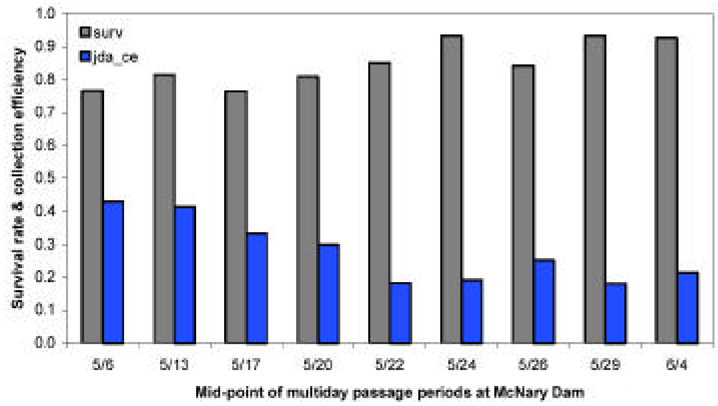
The McNary Dam tailrace to John Day Dam tailrace component of the overall lower river survival estimate showed differences in survival over the time period of passage. Within the shorter reach, the release numbers per block provided detection numbers at Bonneville Dam between 1,657 and 2,959 fish (average 2,137). These recapture numbers were large enough to provide survival estimates in the reach between McNary Dam tailrace and John Day Dam tailrace with standard errors (c-hat adjusted) <0.063.

Table 2. Yearling chinook survival estimate (S) from McNary Dam tailrace to John Day Dam tailrace, 2001, along with estimated collection efficiency (ce) at John Day Dam.

date range	S	se(S)	ce	se(ce)
5/1-5/10	0.7660	0.0195	0.4306	0.0116
5/11-5/15	0.8148	0.0240	0.4133	0.0105
5/16-5/18	0.7647	0.0265	0.3336	0.0094
5/19-5/21	0.8080	0.0341	0.2980	0.0101
5/22-5/23	0.8505	0.0373	0.1822	0.0088
5/24-5/25	0.9322	0.0363	0.1916	0.0073
5/26-5/27	0.8418	0.0267	0.2512	0.0088
5/28-5/30	0.9326	0.0625	0.1809	0.0090
5/31-6/9	0.9268	0.0536	0.2138	0.0074
Weighted mean	0.8238	0.0204	------	-------
Simple mean	0.8486	0.0226	0.2772	0.0325

Estimated survival of yearling chinook from McNary Dam tailrace to John Day Dam tailrace in 2001 ranged from around 76% early in the season to around 93% late in the season. The chi-square test value of 25.47 was significant (greater than the significance level of X^2[8 df, 0.05] = 15.51), and so temporal differences were greater than what is expected by random chance. This lead to the need to determine during which date ranges the significant changes in survival were occurring. As shown in Figure 1, the first four periods through May 21 appeared to have lower survival than during the next five periods. Chi-square tests of the temporal survival estimates within each of these two extended periods showed non-significant

Figure 1. Yearling chinook survival from McNary Dam tailrace to John Day Dam tailrace and collection efficiency at John Day Dam in 2001



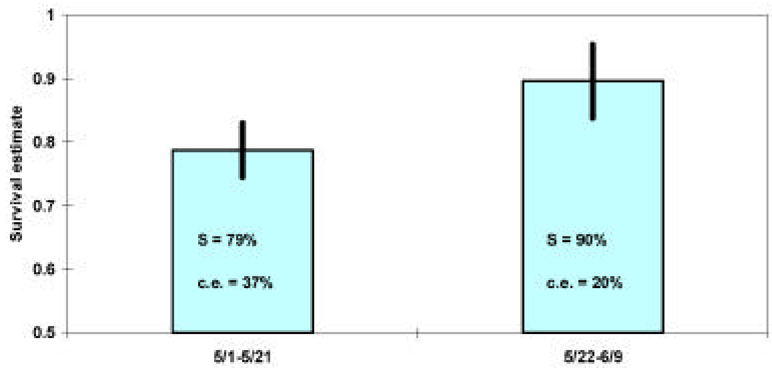
values of 3.04 (less than the significant level of X^2[3 df, 0.05] = 7.81) and 4.21 (less than the significant level of X^2[4 df, 0.05] = 9.49), respectively. It was apparent that the migration was split into two extended blocks of time, pre- and post-May 21, during which survival was fairly homogenous within the temporal block but significantly different between temporal blocks. The collection efficiency at John Day Dam also showed a difference between the pre-May 21 and post-May 21 temporal blocks (Table 2 and Figure 1), dropping from 43% to 30% during the first four periods, and fluctuating between 18% and 25% during the last five periods

For the four periods through May 21 and five periods after May 21, 2001, the unweighted mean survival estimate for yearling chinook from McNary Dam tailrace to John Day Dam tailrace was 78.8% and 89.7%, respectively (Table 3 and Figure 2). This reflects an approximate 14% increase (11 percentage points) in survival between the pre- and post-May 21 temporal blocks. The collection efficiency at John Day Dam for yearling chinook dropped from an average of 37%

Table 3. Yearling chinook and steelhead survival estimates (S) from McNary Dam tailrace to John Day Dam tailrace, 2001, along with estimated collection efficiency (ce) at John Day Dam (unweighted mean estimates for yearling chinook; single point estimates for steelhead).

date range	Blocks	S	se(S)	ce	se(ce)
YEARLING CHINOOK					
5/1-5/21	4	0.7884	0.0134	0.3689	0.0317
5/22-6/9	5	0.8968	0.0207	0.2039	0.0132
STEELHEAD					
5/1-5/21	1	0.3138	0.0201	0.3993	0.0291
5/22-6/9	1	0.3807	0.0563	0.0963	0.0164

Figure 2. Yearling chinook survival from McNary Dam tailrace to John Day Dam tailrace in 2001

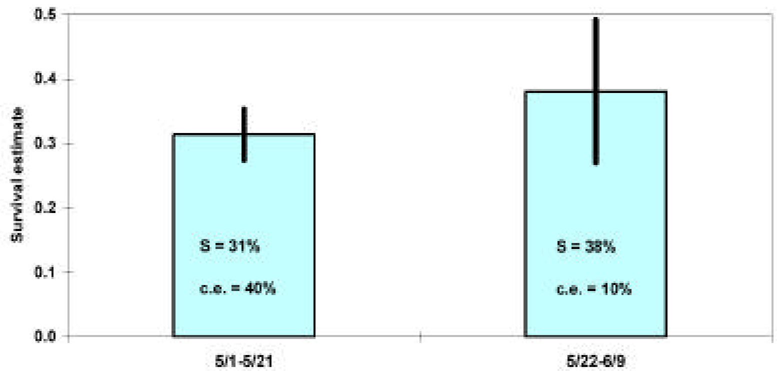


to 20% between the pre-May 21 and post-May 21 temporal blocks (Table 3). The question of whether this same trend in survival and collection efficiency was occurring with steelhead was next to be investigated.

<u>Steelhead reach survival estimates from McNary Dam tailrace to John Day Dam tailrace in 2001</u>

Because the number of PIT tagged steelhead passing McNary Dam in 2001 was only about 4% of the number of PIT tagged yearling chinook, it was not possible to create more than a couple of periods over the steelhead migration season. Therefore a pre- and post-May 21 set of periods was established for steelhead with 2,163 PIT tagged steelhead in the May 1-21 period and 3,165 PIT tagged steelhead in the May 22-June 9 period. These release numbers for the two blocks were providing detection numbers at Bonneville Dam of 272 and 308 fish, respectively, large enough to provide survival estimates in the reach between McNary Dam tailrace and John Day Dam tailrace with standard errors <0.057. The point estimate of survival estimate for steelhead from McNary Dam tailrace to John Day Dam tailrace was 31.4% and 38.1%, respectively, in the pre- and post-May 21 temporal blocks (Table 3 and Figure 3). This reflects an approximate 21% (7 percentage points) increase in survival between the two blocks. The collection efficiency at John Day Dam for steelhead dropped from 40% to 10% between the pre-May 21 and post-May 21 temporal blocks (Table 3).

Figure 3. Steelhead survival from McNary Dam tailrace to John Day Dam tailrace in 2001



Effects of John Day Dam spill on smolt survival in 2001

It was apparent that both yearling chinook and steelhead passing McNary Dam after May 21 experienced conditions that improved their in-river survival. No spill occurred at John Day Dam in 2001 prior to May 25, so nearly all yearling chinook and steelhead passing McNary Dam between May 1 and May 21 would pass John Day Dam before the spill commenced. Most yearling chinook and steelhead passing McNary Dam between May 22 and June 9 would pass John Day Dam during the spill period of May 25 to June 15. Spill volume during the 22-day spill period average 13.2% of the daily average flow at John Day Dam (Table 4). Estimated collection efficiency dropped approximately 45% for yearling chinook and 75% for steelhead when the third route of passage, i.e., spill, was added between May 25 and June 15 (see Table 3), indicating that during this time many smolts would now be using the spill route of passage. So even though the proportion of spill at John Day Dam was relatively low (averaging 13.2%), there appears to be a large movement of both yearling chinook and steelhead passing through the spill route under the extremely low flow conditions (averaging 138 kcfs) in the lower Columbia River at that time. Average flows in the lower Columbia River remained fairly similar for yearling chinook and steelhead passing McNary Dam after May 1 (Table 4). The lower average flows in April would be experienced by smolts originating in tributaries below McNary Dam that were migrating at that time. Which stocks were passing John Day Dam before and during the spill period of 2001 was the next question to address.

Table 4. Flow and spill conditions during springtime migration at John Day Dam in 2001.

Time period	Average Flow	Average Spill	Spill percentage
April 1 – April 14	113.7 kcfs	None	0.0%
April 15 – April 30	110.8 kcfs	None	0.0%
May 1 – May 24	132.3 kcfs	none	0.0%
May 25 – June 15	138.1 kcfs	18.2 kcfs	13.2%

Stocks affected by the springtime spill

Yearling chinook and steelhead stocks that originated in the Walla Walla, Umatilla and John Day rivers appeared to mostly pass John Day Dam in 2001 before the spill period commenced. The percent of PIT tagged yearling chinook from the Umatilla and John Day rivers detected at John Day Dam before the spill began was approximately 92% and 98%, respectively (Table 5). The percent of PIT tagged steelhead from the Walla Walla, Umatilla, and John Day rivers detected at John Day Dam before the spill began was approximately 87%, 87% and 92%, respectively (Table 6). Yearling chinook from the Yakima River basin and yearling chinook and steelhead originating in the Mid-Columbia River basin at or above Rock Island Dam had at least 50% of their detections during the spill period at John Day Dam. The PIT tagged chinook and steelhead from the Snake River basin also had detection percentages around 50% during the spill period. But since most unmarked chinook and steelhead were transported from the Snake River basin in 2001, there would be very few smolts from that basin passing John Day Dam in-river at any time in 2001.

Table 5. Proportion of PIT tagged yearling chinook detected at John Day Dam over specific periods of the 2001 migration season. May 25 - June 16 was the only spill period at John Day Dam in 2001.

Dates of PIT tag detections at John Day Dam	Snake R basin	Mid-Columbia R basin at/above Rock Island Dam[1]	Yakima R basin	Umatilla R basin	John Day R basin
Total detections	14,086	2,091	4,041	1,291	1,743
3/30 – 4/30	0.0002	0.0000	0.0084	0.1332	0.5295
5/1 – 5/24	0.3369	0.1836	0.3606	0.7854	0.4509
5/25 – 6/15	0.5422	0.6738	0.5048	0.0736	0.0132
6/16 – 9/15	0.1207	0.1425	0.1262	0.0077	0.0063

[1] PIT tagged hatchery chinook released on alternating days at Rock Island and Rocky Reach dams in large numbers for specific studies were omitted because they do not represent the timing of the run-of-the-river fish.

Table 6. Proportion of PIT tagged steelhead detected at John Day Dam over specific periods of the 2001 migration season. May 25 - June 16 was the only spill period at John Day Dam in 2001.

Dates of PIT tag detections at John Day Dam	Snake R basin	Mid-Columbia R basin at/above Rock Island Dam	Walla Walla R basin	Umatilla R basin	John Day R basin
Total detections	440	59	23	1,005	97
3/30 – 4/30	0.0045	0.0000	0.0000	0.1124	0.3093
5/1 – 5/24	0.4841	0.1525	0.8696	0.7532	0.6082
5/25 – 6/15	0.3886	0.5254	0.0870	0.1085	0.0825
6/16 – 9/15	0.1227	0.3220	0.0435	0.0259	0.0000

Conclusions:

- Significant increases in survival between McNary Dam tailrace and John Day Dam tailrace were observed for both yearling chinook and steelhead migrating past McNary Dam after May 21.
- This time is coincident with the initiation of spill at John Day Dam.

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- The initiation of spill is evidenced by the decrease in collection efficiency at the John Day Project.

- Data from 2001 prior to the beginning of spill showed that FGE at John Day Dam under low flow conditions was under 40%, a level lower than the 57% value recommended by NMFS in the past for use in modeling exercises. With even the moderate spill provided in 2001 under the existing low flow conditions, there was a large decrease in estimated collection efficiency of the bypass system at John Day Dam, indicating substantial movement of smolts through the spillway route.

- The duration of the spill program was too short to afford protection to all stocks migrating through the lower Columbia River.

- Most chinook and steelhead from the Snake River Basin were transported in 2001.

- With the lower fish guidance efficiency of the turbine intake screening devices (FGE) at dams such as John Day and Bonneville dams compared to those in the Snake River and McNary Dam, plus no screening devices at The Dalles Dam, spill is considered an important mitigation for increasing the survival of smolts migrating through the lower Columbia River hydro system.

- Therefore, it would appear prudent that even in extremely low flow years such as 2001, that spill is provided.

Fish Passage Center
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TELEPHONE LOG # 01-50:

CALL DATE: 10/10/01

CALL FROM: Bruce Suzumoto

CALL TO: Margaret J. Filardo

SUBJECT: IT Presentation

DISCUSSION: Bruce called and asked about the presentation that we had given last Thursday at the IT meeting. He asked if we had any additional information. I told him that the entire Power Point presentation was on our web site. Bruce asked if anything was written up yet. I said that we had been asked the previous month to put together a summary of the 2001 migration for the IT. I told Bruce that we had done all the analyses in that month that we would normally do for the annual report, and that we would be writing it in the next several weeks for the annual report. Bruce said that some of the staff at the NPPC were interested in the information. I told Bruce that we would be happy to explain any specific questions that they might have.

Bruce also asked me an additional question, which was if I thought the low steelhead survival could be explained on the basis of tern predation. I told Bruce that while the question of tern predation had been brought up by the Mid Columbia PUDs at the IT meeting I did not think it could be used to explain the mortality. I told Bruce that I had no doubt that an increase in numbers of birds was observed in the Mid Columbia and could possibly have been related to the stranding caused by the peaking operations. However, the survival of steelhead was extremely low both in the Snake and in the lower Columbia, which do not have the same observations of tern presence. Therefore, it seems unlikely that terns alone can be used to explain the mortality. I suggested that perhaps there were additional factors, like size and timing that could also be contributing to a higher mortality rate.

I told Bruce to let me know if he needs anything else.

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MEMORANDUM

TO: FPAC

Michele DeHart

FROM: Michele DeHart

DATE: July 5, 2001

RE: Navigation in the Columbia and Snake Rivers FPC request for technical review

In response to your request we investigated the question of how much water and how many megawatts are foregone by navigation lockages through the Snake and Columbia River projects. As you recall NMFS had requested that the COE provide calculated estimates of the amount of water and the megawatts of generation foregone by navigation lock operation. Chris Ross, NMFS initially received some average estimates of number of navigation lock passages in an email from the COE. No further information was received in response to the NMFS request.

As requested, we pursued the question. The following discussion describes the process we went through to develop the estimates of water use and megawatts foregone by navigation lock operations. We are requesting that FPAC review the process and logic we utilized for errors and flaws. It would be particularly helpful if your engineering staffs would provide input.

Gathering the data

The first step was to gather the actual data on size, width and length, of the locks at each project. We were able to find this for each project on the COE Internet pages. The lift or height of each lock was taken from the COE 30 day reports for each project for each month in 2000. We utilized 2000 data for lift because we could only get complete data on number of lock passages per month for 2000. We were forced to use 2000 data for number of lock passages and therefore lift, because the lock passage data for 2001 was not available for another 30 days. Using 2000 data would provide an idea of the water volume and megawatt impact of navigation passages. COE districts staffs graciously provided the 2000 data for number of navigation lock passages at each project by month for April, May, June, July and August for 2000. We limited our consideration to these months because these are the months in which use of water, and foregoing megawatts has the most impact on fish passage.

Calculating the volume of water passed through locks

For each project we calculated the cubic feet of water used in each lock passage.

By multiplying average monthly lift, feet, (height) x length, feet, x width, feet to get the cubic feet of water passed through each navigation lock. We transformed the cubic feet of water to acre-feet of water: 1 cubic foot = .00002295 acre-feet. This gave us the acre-feet of water used in each lock passage. We multiplied this times the number of lock passages per month to get the number of acre-feet used in lock passages per month at each project in 2000. Using this formula we estimate the following :

	April 2000			May 2000			June 2000		
	Month Ave lift	Cubic Ft per lockage	Acre-feet per lockage	Month Ave lift	Cubic Ft per lockage	Acre-feet per lockage	Month Ave lift	Cubic Ft per lockage	Acre-feet per lockage
BON	52.03	3020341.5	69.3	52.35	3038917.5	69.7	55.54	3224097.0	74.0
TDA	77.30	4487265.0	103.0	78.11	4534285.5	104.1	79.94	4640517.0	106.5
JDA	100.81	5800002.5	133.1	101.30	5828194.2	133.8	102.33	5887454.2	135.1
MCN	71.32	4140126.0	95.0	71.55	4153477.5	95.3	72.54	4210947.0	96.6
ICH	92.57	5294078.3	121.5	93036	5339258.4	122.5	95.05	5435909.5	124.8
LWM	97.60	5590137.6	128.3	98.12	5619921.1	129.0	99.06	5673760.6	130.2
LGS	95.63	5493752.2	126.1	95.45	5483411.6	125.8	95.69	5497199.1	126.2
LWG	98.8	5735340.0	131.6	99.30	5764365.0	132.3	99.96	5802678.0	133.2

	July 2000			Aug 2000		
	Month Ave lift	Cubic Ft per lockage	Acre-feet per lockage	Month Ave lift	Cubic Ft per lockage	Acre-feet per lockage
BON	58.87	3417403.5	78.4	60.7	3525376.5	80.9
TDA	81.22	4714821.0	108.2	81.81	4749070.5	109.0
JDA	103.24	5939810.2	136.3	103.95	5980659.3	137.3
MCN	72.92	4233006.0	97.1	73.62	4273641.0	98.1
ICH	96.92	5542854.8	127.2	97.87	5597185.3	128.5
LWM	99.25	5684643.0	130.5	99.58	5703544.1	130.9
LGS	95.74	5500071.5	126.2	95.76	5501220.5	126.3
LWG	100.14	5813127.0	133.4	100.3	5822415.0	133.6

The total AF per month per project utilized by navigation lock passages follows:

	April 2000		May 2000		June 2000		July 2000		August 2000	
	# Lockages	Acre feet	# Lockages	Acre feet	# Lockages	Acre feet	# Lockages	Acre feet	# Lockages	Acre feet
BON	301	20,864	347	24,201	282	20,866	363	28,470	352	28,479
TDA	254	26,158	302	31,427	250	26,625	268	28,999	283	30,845
JDA	239	31,813	258	34,509	191	25,807	238	32,444	257	35,275
MCN	218	20,713	261	24,879	206	19,908	229	22,247	231	22,656
ICH	183	22,234	261	31,982	217	27,072	229	29,131	231	29,673
LWM	133	17,063	179	23,087	139	18,100	152	19,830	231	30,237
LGS	140	17,651	171	21,519	146	18,419	151	19,060	157	19,822
LWG	102	13,426	118	15,610	120	15,981	170	22,680	246	19,903

Calculating Megawatts foregone due to lock passages
Calculating the megawatts foregone was necessary because the COE did not respond to the NMFS request for this information. Calculating the megawatts from the volume of water passed through locks was most problematic because we did not have a standard methodology for the calculation that allowed us to compare directly to the accounting for the spill program. In the email received from the COE we were given the following general formula for calculating megawatts that would be generated at a particular project from the flow and head:
Ave size 84ft x690 ft x head x height x H/k = MW,

The COE gave us the following table of values which includes MW per lock cycle were:

Project	Ave. Head feet	H/k	MW per Nav. Lock cycle
Bonneville	64 ft.	4.6	4.7
The Dalles	83 ft.	6.2	8.3
John Day	104 ft.	7.6	12.6
McNary	74 ft.	5.4	6.4
Ice Harbor	98 ft.	7.2	11.4
L. Monumental	100 ft.	7.3	11.7
Little Goose	98 ft.	7.2	11.4
Lower Granite	99 ft.	7.3	11.7

Using this data from the COE for megawatts per lock cycle and number of lock passages per month we get the following number of megawatts per month per project.

Project	April 2000		May 2000		June 2000		July 2000		August 2000	
	# lock	MW	#lock	MW	#lock	MW	#lock	MW	#lock	MW
Bonneville	301	1414	347	1630	282	1325	363	1706	352	1654
The Dalles	254	2108	302	2506	250	2075	268	2224	283	2348
John Day	239	3011	258	3250	191	2406	238	1738	257	3238
McNary	218	1395	261	1670	206	1318	229	1465	231	1478
Ice Harbor	183	2086	261	2975	217	2473	229	2610	231	2633
L. Monumental	133	1556	179	2094	139	1626	152	1778	231	2702
Little Goose	140	1596	171	1949	146	1664	151	1721	157	1789
Lower Granite	102	1193	118	1380	120	1404	170	1938	246	2878
day ave. MW /30-31		469		563		476		489		603
Megawatt months /24		19.5		23.45		19.8		20.3		25.1

However, the spring spill program was discussed in megawatt months not instantaneous or day average megawatts. In order to compare MW foregone due to lock passage in the same terms as the 600 MW month average spill program discussed in the region, the total MW for each month were divided by the days in the month and hours in a day. By this method, it appears that lockages in April, May, June, July and August, came close to 108-megawatt months. This roughly equates to approximately 20% of the total spring spill program in 2001.

Alternative methodology Kcfs to megawatt months

In order to confirm the estimates that we derived using data from the COE, we developed the megawatt months from an alternative method. In the development of the 2001 spring spill program a spreadsheet was provided by the Bonneville Power Administration that transformed Kcfs to megawatt months based on the H/K specific to each project. In order to use this method the total acre-feet per month per project from Table 3 was used to estimate the Kcfs.

	April		May		June		July		August	
Project	Kcfs	MW-Months	Kcfs	MW-Months	Kcfs	MW-Months	Kcfs	MW-Months	Kcfs	MW-Months
Lower Gr	0.23	1.56	0.25	1.81	0.27	1.86	0.37	2.64	0.54	3.82
Little Goose	0.30	2.05	0.35	2.50	0.31	2.14	0.31	2.22	0.32	2.30
Lower Mon	0.29	1.98	0.38	2.68	0.30	2.10	0.32	2.30	0.49	3.51
Ice Harbor	0.37	2.51	0.52	3.61	0.46	3.06	0.47	3.29	0.48	3.35
McNary	0.35	1.79	0.41	2.15	0.34	1.72	0.36	1.92	0.37	1.96
John Day	0.54	3.86	0.56	4.18	0.43	3.13	0.53	3.93	0.57	4.28
The Dalles	0.44	2.52	0.51	3.03	0.45	2.56	0.47	2.79	0.50	2.97
Bonneville	0.35	1.39	0.39	1.61	0.35	1.39	0.46	1.89	0.46	1.89
Total		**17.66**		**21.58**		**17.96**		**20.98**		**24.08**

The total number of mega-watt months estimated with this procedure for the 2000 lockages was 102.25 average mega-watt months. This method corroborates the estimates derived previously.

Conclusion

This exercise provides an idea of the magnitude of water use and megawatt impact of navigation passage in comparison to spill. However this is only a conceptual exercise since the number of lock passages for 2001 is not available at this point. A more meaningful comparison of the water used and megawatts foregone by navigation locks operations to the limited spring spill for fish passage will be possible when the navigation lock passages are available for 2001. We recommend that this exercise be repeated with the actual lock passage data for 2001 when it becomes available. Discussions in the management arena should be delayed until the actual 2001 data is available. Keep in mind that the megawatt impact of lock operations is larger than discussed in this memo, because lock passage occurs year around, and we limited out review to lock passages that occurred in fish passage months in which spill has been curtailed. Please provide your comments to Margaret or Michele.

Joint Technical Staff Memorandum

CRITFC, IDFG, NPT, USFWS, WDFW

TO: Brian Brown, NMFS
Jim Ruff, NMFS
Paul Wagner, NMFS
Chris Ross, NMFS

FROM: Bob Heinith,
Columbia River Intertribal Fish Commission

Greg Haller,
Nez Perce Tribe

Steve Pettit,
Idaho Department of Fish and Game

James Nielsen,
Washington Depart. of Fish & Wildlife

David Wills,
US Fish and Wildlife Service

DATE: April 17, 2001

RE: NMFS Peaking, Pulsing and Surging Operations Proposal

We would like to thank you for providing us with the opportunity to review your proposal. These comments follow the discussion and subsequent agreement at the April 3, 2001 FPAC conference call. After discussing the proposal, we present agreed that:

- We do not agree with the peaking and pulsing proposal presented by NMFS.
- The existing data does not prove that peaking and pulsing flows will result in more fish being collected than would occur without peaking and pulsing. Peaking and pulsing flows will not mitigate for the provision of flows.
- Radio tagging from the Lewiston trap would provide additional monitoring information that would be useful this year regardless of the project operations that are in place. However, we do not believe that radio tag monitoring can provide conclusive data on the efficacy of peaking

and pulsing or any other operations. We do not believe that the proposed radio tagging work will comprise a conclusive evaluation of peaking and pulsing.

- Most of the salmon managers present at the meeting did not agree with using flow augmentation from Dworshak in the spring. Using flow augmentation from Brownlee in the spring would be preferable to enhance spring flows for yearling chinook and steelhead.
- In reviewing hourly flows which occurred at Snake River projects in the low flow years of 1992 and 1994, it is obvious that peaking and pulsing took place as part of the normal project load following. The results from 1992 and 1994 are the results from peaking and pulsing operations.
- The alternative block study design recently provided by NMFS does not resolve the issues previously discussed regarding the inability of the proposed evaluation to provide conclusive results. In fact, it further illustrates that the results have a high probability of being inconclusive.

As we understand your objective, you wish to test river pulsing as a management strategy for increasing the survival of juvenile salmonids survival this year. In order to evaluate whether or not your strategy works, you propose to use the radio tags originally targeted for the surface bypass collection research (which will not be conducted this year). The radio tagged fish will be used in conjunction with the passage index information to determine success or failure. After reviewing your proposal and past year's data we have the following concerns.

1. We agree that increases in project flow result in increases in project passage. In every year that we have conducted the SMP, and at every project, we observe increases in project passage relative to increases in flow (Fig 1). We understand that you would like to capitalize on this phenomenon. However, most of these increases in flow are related to natural phenomena (rain events), flow augmentation or project operations for maximizing energy production. The problem with this operation in a low flow year is that given the limited, or non-existent, volumes of flow augmentation, the use of water in a peaking fashion will always have a downside during the low flow period following the peak. In 1991 we reviewed the use of peaking operations and its impact on subsequent travel times after the event (see attached memo) and concluded this was not likely the best approach to juvenile fish migration management. In FPAC discussions full agreement was reached that peaking and pulsing would not decrease travel time.
2. Unlike a rain event or release of large and sustained volumes of augmentation water, the operations you propose will likely only affect fish immediately in front of the project. The following lower flow day will also reduce the collection during the low flow period. There is no data available that validates the assumption that peaking and pulsing flows will result in a higher seasonal total number of fish collected, compared to the normal power operation that will be in place. Since the peaking and pulsing concept only affects fish in the immediate forebay, there is no basis to assume that overall smolt survival will increase. In fact, the opposite could occur if during lower flow periods fish can make substantial progress swimming upstream in the forebay.
3. The use of radio-tagged fish for the purpose of evaluating the effect of a "pulse" is problematic. There is no baseline condition to use in a comparison of this years' radio tagged fish information. Any information has inherent in it the facilities project operation. We have attached a graph depicting hourly flow operations at Lower Granite Dam for the 1992 and 1994 low flow years. As seen in the graph the daily fluctuations in flow for power production are significant, and will likely confound any

response measured in the radio-tagged fish. In addition, the short tag life (8 days) force the fish to be released close to the project. The information cannot be extrapolated to fish entering and traveling through the entire reservoir.

4. The alternate block study design proposed by NMFS does not include a true control. It is not clear what will be measured in the study. The radio tags will show movement of fish, but how this movement will be translated into some type of measurement that could be compared between Treatment days and Control days is not presented. Fish distribution at the face of the powerhouse, which NMFS allows are the only fish that will be affected, will be directly impacted by the project operations that occurred on the previous day. The block design assumes that fish at the face of the powerhouse on a given day are there independently of the project operations in the previous period. In past years it has been observed that on low flow days fish can make substantial progress swimming back upstream in the reservoir. Again, it will not be possible to determine if more fish are collect seasonally with this operation. Variations occur in both daily average flows and in 24 hourly flows within a day on the order of magnitude of the proposed pulse. Collection counts at the project are expected to rise in the early evening hours (7-10 p.m. PDT) of any day based on PIT tag detection data. Following the daytime period of higher flows for power generation, we would expect there will be increasing smolt passage. It is not clear whether the study as proposed would be able to discern how much increased passage is due to the flow increase or simply the diel smolt passage pattern that occurs at Lower Granite Dam.

5. Given the proposed block design, the lack of a true "control" condition, and the limited number of study days (8 total), it is impossible to determine the probability of being able to detect:

a) A difference between the response to the proposed pulse and response to background conditions; or

b) The effect of the refill day on overall passage, (i.e. an actual decrease in collection due to the pulse and refill)

We do not believe that a “survival benefit” from the peaking operation can be assessed. We recommend against using the limited volume of natural and augmented water available this year in this way. We suggest that this water could be more appropriately used to maintain the natural flow peak for a longer period of time this spring if the biological data collected this year indicates this is necessary, or for summer flow augmentation and temperature regulation. Specifically the federal parties should pursue flow releases from Brownlee in May to augment spring flows at Lower Granite.

Radio tag the juvenile Chinook as you proposed. This will give you information regarding the general behavior of fish migrating in these extremely poor conditions. You need to acknowledge up-front that these data are limited due to the tag-life and the need to release fish close to the project. Consequently, you will not gain much knowledge regarding travel through the reservoir.

In summary, we recognize your desire in this extremely hazardous fish passage year to implement some operation that would present benefits for fish. However, we do not agree that the potential risks associated with the operation you propose would justify its implementation. It is also highly unlikely that you would be able to show any survival benefit to fish from the radio tagging or passage index information you propose to collect. The utilization of Brownlee Reservoir to augment May passage flows at Lower Granite, refilling Brownlee from Upper Snake River releases would have much more potential for mitigating the disastrous passage conditions occurring at the present time.

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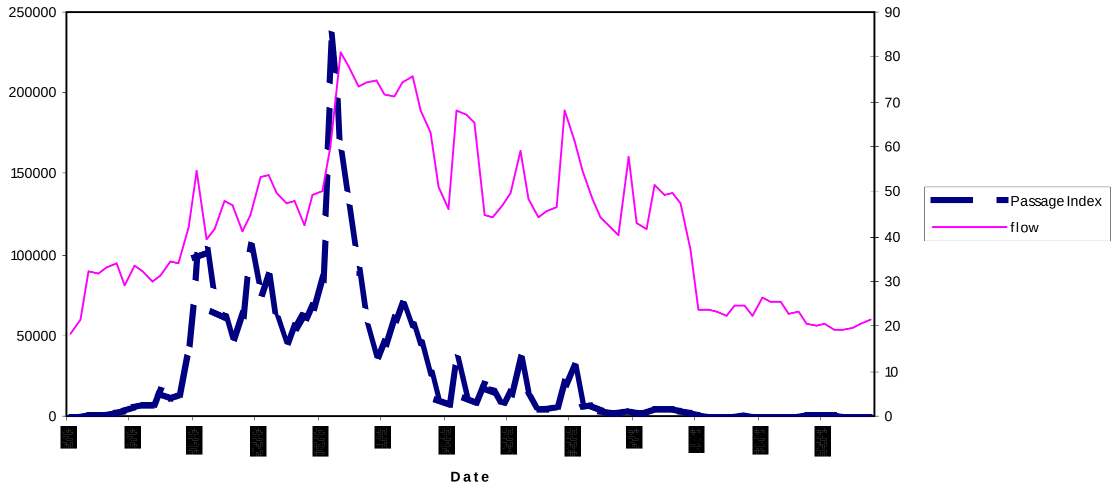
Passage Index versus Flow for 1992 at Lower Granite Dam



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MEMORANDUM **REVISED**

TO: Salmon Managers

Michele DeHart

FROM: Michele DeHart

DATE: May 23, 2001

RE: Travel time from traps to Lower Granite Dam in 2001

The Fish Passage Center staff reviewed the PIT tag travel time data from the Smolt Monitoring Program under the current low flows occurring in 2001 in order to assess the status of this year's migration.

There are certain inherent difficulties in assessing in-season travel times that must be taken into consideration. The primary complication is the fact that travel time can only be determined on the fish that survive to a given dam. In extremely bad migration years such as 2001, the chance of survival of smolts may decrease over time so that fewer of the slower migrating smolts arrive at the dam compared to the faster migrating smolts. This causes the average travel time (as well as median travel time) of a group of fish to appear shorter than what would occur if all fish had an equal chance of survival. Low survivals or truncated passage distributions, which occur in bad migration conditions, affect the average travel time making it appear faster. We have addressed this problem in the travel time estimates from the traps to Lower Granite Dam by estimating average weekly travel times and estimating minimum travel times. For these groups, in addition to average travel times, we have compared the 2001 travel times of the fastest fish with the 2000 travel times of the fastest fish. Travel time was also estimated for PIT tagged yearling chinook and steelhead in the lower Columbia River between McNary and Bonneville dams.

Our summary assessment of the present travel time status of the juvenile migration to date is:

- Travel time of PIT tagged yearling chinook and steelhead through the lower Columbia River from McNary Dam to Bonneville Dam in 2001 is about two times longer than it was in 2000
- The fastest fish travel times in 2001 from trap sites to Lower Granite Dam are 20% to 231% longer than fastest fish travel times in 2000,
- Weekly average travel times from trap sites to Lower Granite Dam are 6% to 175% longer in 2001 when compared with 2000.
- Travel time and passage index data indicate that the present hydrosystem operations, load following, elimination of spill for fish passage at most projects, and low flows are having a significant detrimental impact on the juvenile spring migration of yearling chinook salmon and steelhead.

Trap Sites to Lower Granite Dam

PIT tag detections at Lower Granite Dam were reviewed. Tag detections through 06:00 May 23 of yearling chinook and steelhead PIT tagged and released from the traps between March 19 and May 5 were utilized. Fish tagged prior to March 19 in each year had very long travel times (40-50 days), indicative of non-active migrating fish. Fish tagged after May 5 in each year were not included in this analysis in order to provide at least a 17-day window of opportunity to pass Lower Granite Dam, thus reducing the impact from fish of these releases that have not yet arrived at the dam as of May 23.

The fact that the migration is not finished is a complication of the in-season assessment of smolt travel time. In order to address this problem, we also looked at the fish with the shortest (minimum) travel time in each group. PIT tagged yearling chinook and steelhead were grouped by week of release for each of the three traps (located on lower Salmon, Imnaha, and Grande Ronde rivers). Tables 1 and 2 show weekly average and minimum travel time, respectively, from trap site to Lower Granite Dam in 2001 compared to 2000. In order to make the data as comparable as possible between the two years 2000 and 2001 prior to completion of the current season, both years were limited to releases made between March 19 and May 5.

Table 1 showed the greatest change in weekly average travel times between 2000 and 2001 for yearling chinook released through mid-April and again in early May. These were the periods of lowest flows at Lower Granite Dam in 2001 and longer travel times during these periods were observed. This same general pattern is developing with steelhead travel times.

The minimum travel time from traps to Lower Granite Dam in Table 2 shows yearling chinook released between April 2 and 15 in 2001 had substantially longer minimum travel times (81-231% higher) than in 2000. Likewise, steelhead released between April 2 and 22 in 2001 had substantially longer minimum travel times (89-147% higher) than in 2000. For the last two weeks beginning April 23, the trend has lessened to 10-90% higher minimum travel times in 2001. The use of minimum travel time has helped collaborate the trend of longer travel times in the weekly average travel times under the lower flows conditions of 2001.

Lower Columbia River Travel Time

Weekly minimum and average travel time from McNary Dam to Bonneville Dam is substantially longer in 2001 compared to 2000 for both yearling chinook and steelhead. Yearling chinook weekly minimum travel times for fish passing McNary Dam between April 21 and May 11 have been 44 to 85% higher in 2001 than 2000, and weekly average travel times have been 57 to120% higher (Table 3). The weekly average travel times will become even higher later as more slow moving fish reach Bonneville Dam after the 06:00 May 23 cut-off for this analysis. Steelhead passage at McNary Dam has been delayed in 2001 to the extent that only a few fish have been detected at both McNary Dam and Bonneville Dam as of the date of this report. The travel times for 2001 steelhead reported in Table 4 are based on only the 13 fish available at this time, while the chinook results were based on sample sizes over the 50 fish threshold set for these analyses. In spite of low numbers, the results for steelhead collaborate what was seen for yearling chinook. The weekly average and minimum travel times for 2001 were 98 to 128% higher than those in 2000.

Table 1. Weekly average travel time for PIT tagged chinook and steelhead (n>50 fish) from Snake River basin traps to Lower Granite Dam in years 2000 and 2001, with percent increase in travel time in year 2001.

Salmon River trap average travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
Week	**2000**	**2001**	**%increase**	**Week**	**2000**	**2001**	**%increase**
1	34.9	37.0	6.0%	**1**			
2	29.6	32.3	9.1%	**2**			
3	19.9	27.6	38.7%	**3**			
4	18.1	20.7	14.4%	**4**		17.1	
5	13.5	15.6	15.6%	**5**	5.7	11.4	100.0%
6	13.6	13.1	-3.7%	**6**	6.8	7.6	11.8%
7	10.6	13.0	22.6%	**7**	5.2	10.4	100.0%

Imnaha River trap average travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
week	**2000**	**2001**	**%increase**	**week**	**2000**	**2001**	**%increase**
1	28.6	32.1	12.2%	**1**			
2	22.0	28.2	28.2%	**2**		35.6	
3	21.2	24.6	16.0%	**3**	9.7		
4	18.7	17.4	-7.0%	**4**	13.3	20.5	54.1%
5	17.1	12.8	-25.1%	**5**	11.4	11.1	-2.6%
6	9.7	11.3	16.5%	**6**	11.0	8.2	-25.5%
7	8.6	11.4	32.6%	**7**	5.5	11.2	103.6%

Grande Ronde River trap average travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
week	**2000**	**2001**	**%increase**	**week**	**2000**	**2001**	**%increase**
1				**1**			
2	17.7	23.5	32.6%	**2**			
3	16.7	27.9	67.1%	**3**	6.5		
4	15.1	22.8	51.0%	**4**	5.9	14.5	145.8%
5	11.8	12.5	5.9%	**5**	6.5		
6	10.7	11.2	4.7%	**6**	4.3	7.1	65.1%
7	7.6	11.5	51.3%	**7**	2.9	8.0	175.9%

Week legend : dates of release

1 March 19–March 25
2 March 26 - April 1
3 April 2 - April 8
4 April 9 - April 15
5 April 16 - April 22
6 April 23 - April 29
7 April 30 - May 5

Table 2. Weekly minimum travel time for PIT tagged chinook and steelhead (n>50 fish) from Snake River basin traps to Lower Granite Dam in years 2000 and 2001, with percent increase in travel time in 2001.

Salmon River trap minimum travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
week	**2000**	**2001**	**%increase**	**week**	**2000**	**2001**	**%increase**
1	20.3	15.7	-22.7%	**1**			
2	8.6	10.4	20.4%	**2**			
3	6.9	14.6	113.0%	**3**			
4	4.6	12.3	168.5%	**4**		7.0	
5	4.3	8.0	86.6%	**5**	2.4	4.6	88.9%
6	4.9	5.5	12.5%	**6**	2.8	3.5	24.9%
7	3.5	5.4	54.3%	**7**	2.4	3.8	58.3%

Imnaha River trap minimum travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
week	**2000**	**2001**	**%increase**	**week**	**2000**	**2001**	**%increase**
1	12.4	6.1	-50.9%	**1**			
2	5.7	9.0	58.6%	**2**		6.4	
3	5.9	10.7	80.7%	**3**	3.0		
4	2.9	8.3	183.8%	**4**	2.2	5.5	147.3%
5	4.0	5.1	26.5%	**5**	1.8	4.4	143.3%
6	4.4	3.5	-21.5%	**6**	2.6	2.9	10.3%
7	4.0	5.0	25.0%	**7**	2.0	3.8	90.0%

Grande Ronde River trap minimum travel time to Lower Granite Dam

Yearling Chinook				Steelhead			
week	**2000**	**2001**	**%increase**	**week**	**2000**	**2001**	**%increase**
1				**1**			
2	7.5	12.4	64.8%	**2**			
3	5.6	10.7	92.4%	**3**	2.5		
4	2.6	8.5	231.4%	**4**	1.6	3.6	118.0%
5	3.4	5.5	64.4%	**5**	1.4		
6	3.4	3.7	10.0%	**6**	1.6	2.4	54.5%
7	2.4	6.1	154.2%	**7**	1.5	1.8	20.0%

Week legend : dates of release

1 March 19 – March 25
2 March 26 – April 1
3 April 2 – April 8
4 April 9 – April 15
5 April 16 – April 22
6 April 23 – April 29
7 April 30 - May 5

Table 3. Weekly minimum and average travel time for PIT tagged yearling chinook from McNary Dam to Bonneville Dam in 2001 compared to 2000.

Passage at MCN	Minimum 2001	Minimum 2000	Change	Average 2001	Average 2000	Change
4/14 – 4/20	12.2			18.9		
4/21 – 4/27	7.2	3.9	84.6%	16.7	7.6	120.0%
4/28 – 5/4	5.5	3.8	44.7%	13.5	7.0	92.9%
5/5 – 5/11	5.6	3.9	43.6%	9.9	6.3	57.1%

Table 4. Weekly minimum and average travel time for PIT tagged steelhead from McNary Dam to Bonneville Dam in 2001 compared to 2000.

Passage at MCN	Minimum 2001	Minimum 2000	Change	Average 2001	Average 2000	Change
4/14 – 4/20		3.4			5.2	
4/21 – 4/27		3.6			5.5	
4/28 – 5/4		3.2			5.5	
5/5 – 5/11	8.2	3.6	127.8%	10.5	5.3	98.1%

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MEMORANDUM

TO: CBFWA Members Group

Michele DeHart

FROM: Michele DeHart

DATE: August 10, 2001

RE: Spring Migration 2001 in response to Request from Brian Allee

In response to a request from Brian Allee, CBFWA, the Fish Passage Center staff reviewed the 2001 passage data for spring migrants. This document presents the preliminary results of analysis of the 2001 spring migration of steelhead and chinook in the Snake and Columbia Rivers.

- Near record low run-off volume, energy deregulation, volatile wholesale power markets and BPA energy and financial emergencies combined to produce poor migration conditions for juvenile spring chinook.
- NMFS Biological Opinion flow targets were never met. Seasonal average flows for the spring period were 48.9 Kcfs at Lower Granite, 126.3 Kcfs at McNary and 76.7 Kcfs at Priest Rapids compared to a Biological Opinion target flow of 85 Kcfs at Lower Granite and 220 Kcfs at McNary.
- Spill was eliminated from Snake River projects and only 600-megawatt months were spilled at Lower Columbia projects.
- River conditions this year produced the poorest survivals since PIT Tag survivals have been estimated (1993). Seasonal survival estimates from Lower Granite to McNary Dam for yearling chinook was estimated at 0.57 and for steelhead 0.16. Average survival for spring chinook in this reach from 1995 to 2000 was 0.72 and 0.70 for steelhead. Wild yearling chinook survival was lower than 2000 in this reach.
- Run timing was affected for both chinook and steelhead with the run beginning later than normal and of a shorter duration than normal.

- Travel times in 2001 were some of the lowest in the twenty years of travel time data, with travel times for spring chinook in the McNary to Bonneville reach doubling when compared to past years.
- The poor flow year was exacerbated by power peaking operations in the mid-Columbia where flows were highest on weekdays and decreased considerably on weekends

2001 Migration Conditions

Low river runoff volume and hydrosystem operation decisions affected the ability to implement the Biological Opinion measures for the 2001 juvenile salmon migration. The July Final Runoff Volume Forecast at The Dalles was 52% of average, and at Lower Granite Dam the volume was estimated at 47% of average. A power system emergency was declared by the Bonneville Power Administration based on concerns relative to power reliability and financial solvency. The declared emergency subsequently determined how the hydrosystem operated in 2001 relative to the provision of fish mitigation measures. Reservoir refill was prioritized in order to provide power and financial reserves for BPA. While flows would have been below the NMFS Biological Opinion levels, this reduction was further exacerbated by the system operation. The resulting spring flows and the Biological Opinion levels are presented in the following table:

Location	Spring Flow Target Kcfs	Actual Flows Kcfs
Lower Granite	85	48.9
McNary	220	126.3
Priest Rapids	135	76.7

In addition to average flows that were well below the Biological Opinion flow targets, flows were fluctuated on a daily and weekly basis to maximize power production and revenue. These daily and weekly variations likely had a deleterious impact on migration conditions.

Because flows in the Snake River were projected to be less than 85 Kcfs, spill was terminated at the Snake projects and transportation was maximized. Transportation was also implemented to collect 50% of the spring migrants at McNary Dam.

Spill normally would have occurred at fairly significant levels between May 1 and June 30 at the lower Columbia projects. However, in 2001 a much curtailed spill program equivalent to a total of 600 MW-months was implemented at The Dalles and Bonneville dams from May 16 to June 15, from May 25 to June 15 at John Day Dam and on alternate days between May 25 and June 15 at McNary Dam.

Figure 1. Daily average flow and spill at Lower Granite Dam compared to Opinion flow and spill targets.

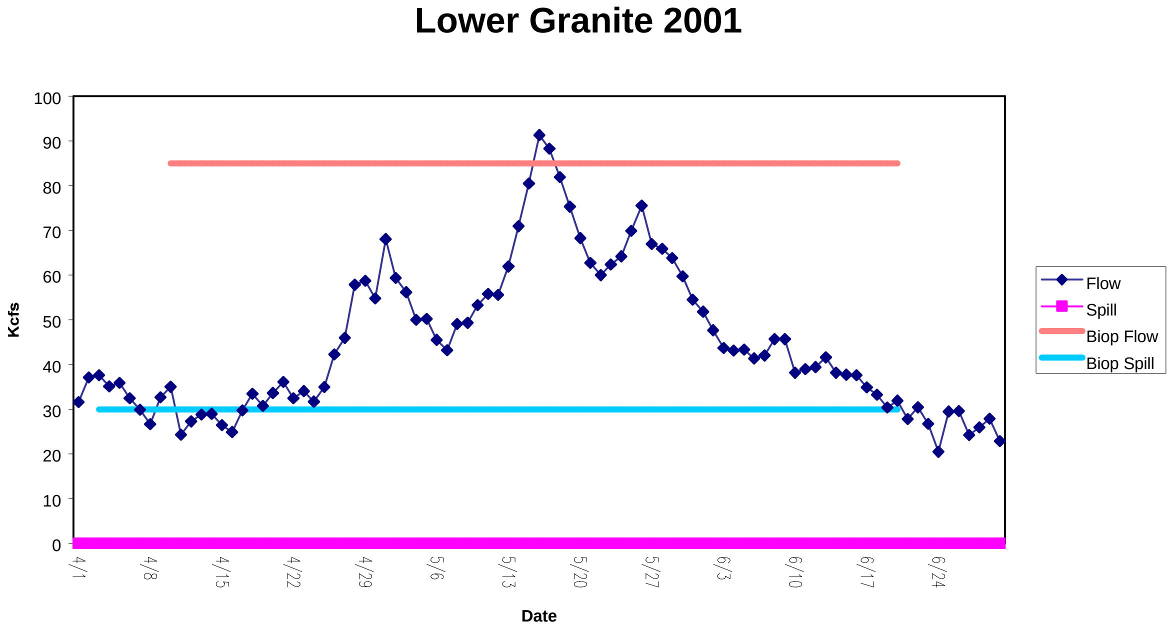


Figure 2. Daily average flow and spill at Little Goose Dam compared to Opinion flow and spill target.

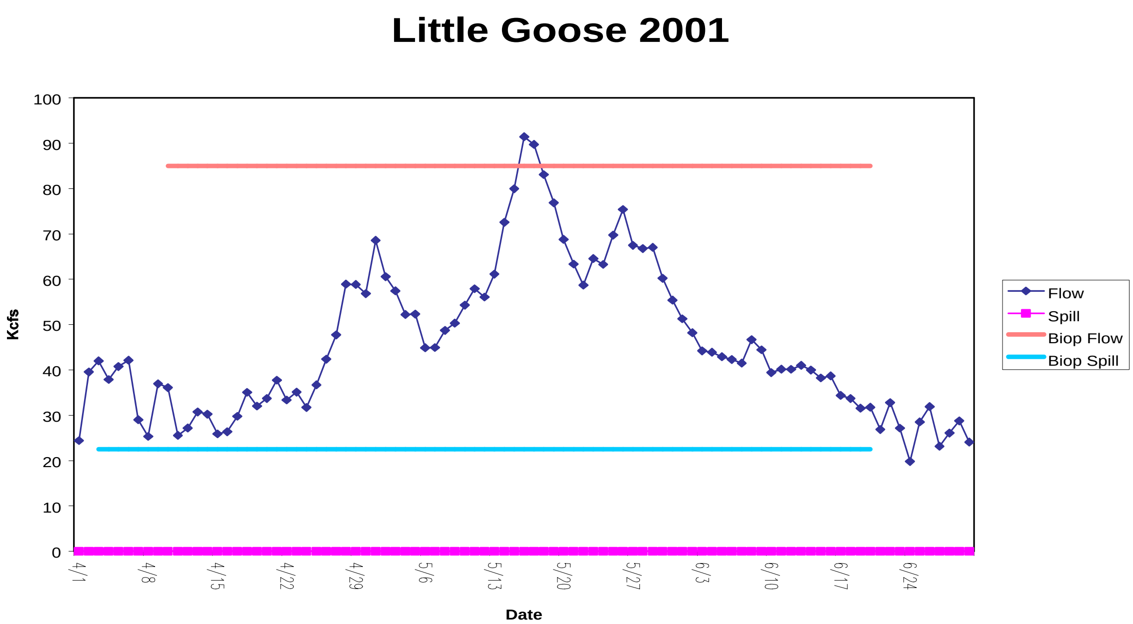


Figure 3. Daily average flow and spill at Lower Monumental Dam compared to Opinion flow and spill targets.

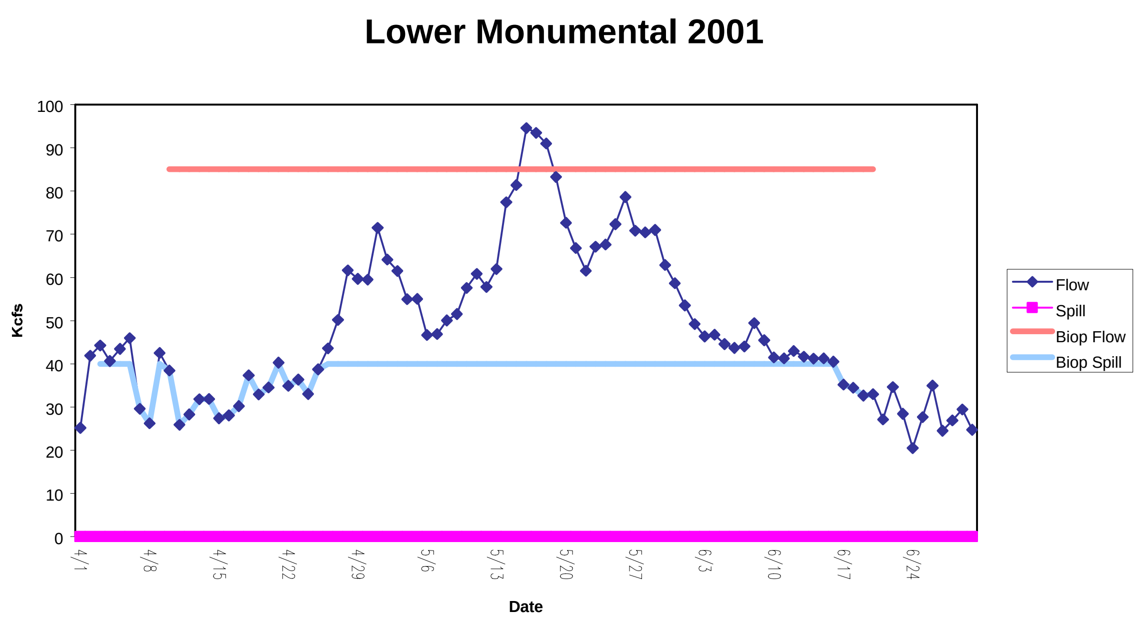


Figure 4. Daily average flow and spill at Ice Harbor Dam compared to Opinion flow and spill targets.

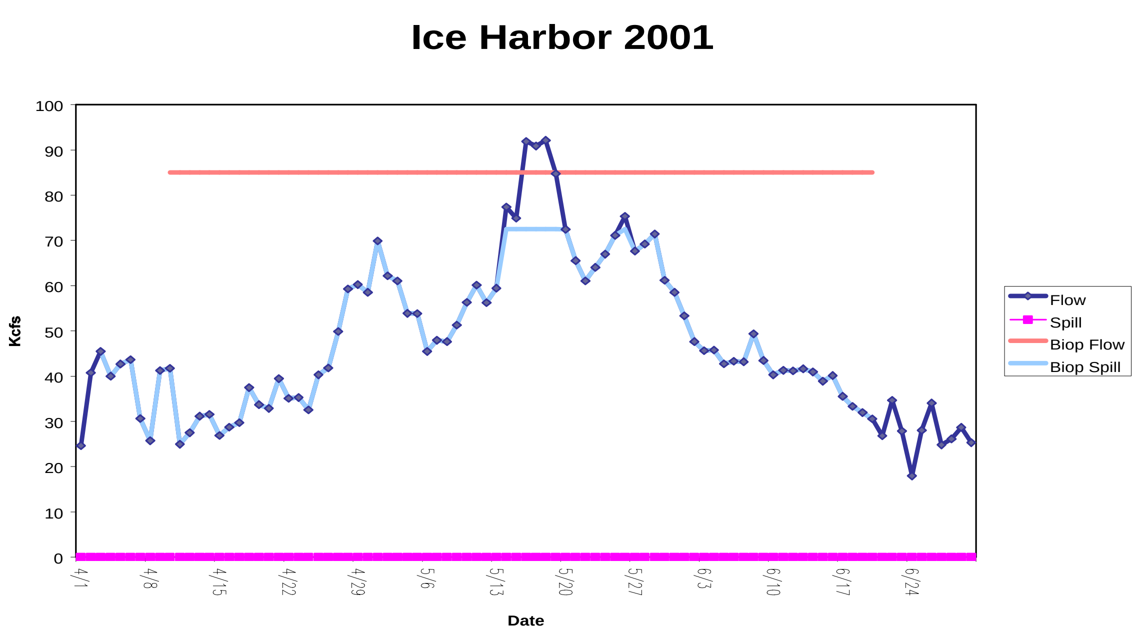


Figure 5. Daily average flow and spill at McNary Dam compared to Opinion flow and spill targets.

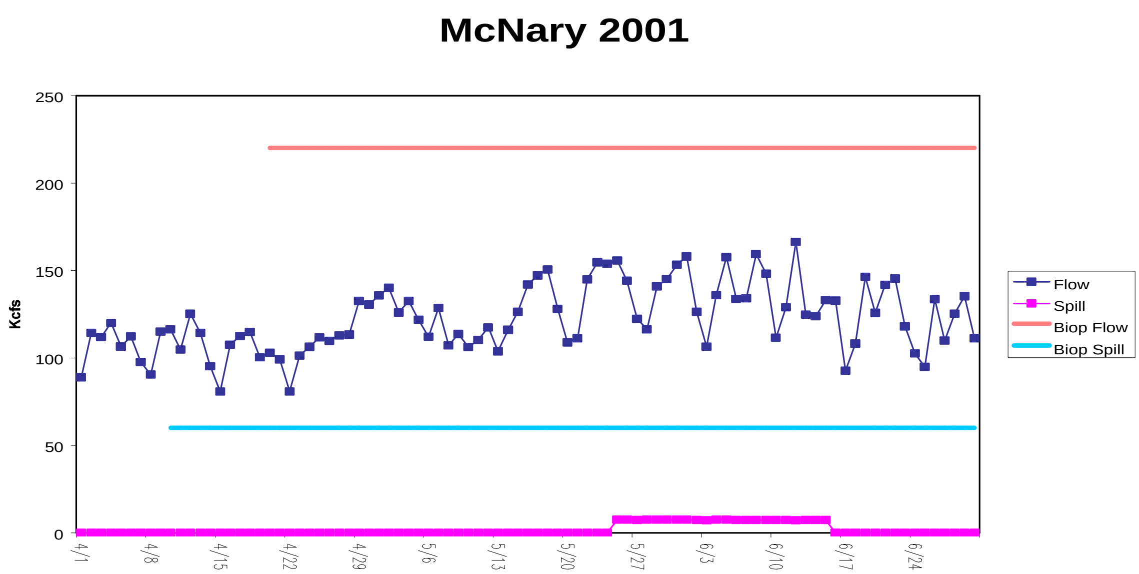


Figure 6. Daily average flow and spill at John Day Dam compared to Opinion flow and spill targets.

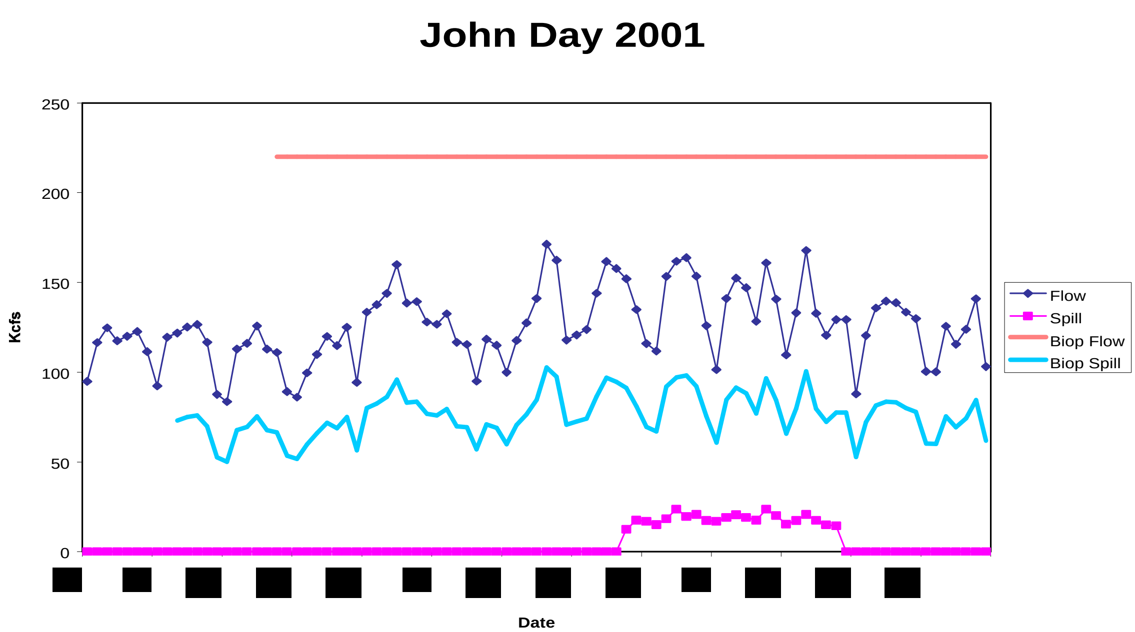


Figure 8. Daily average flow and spill at Bonneville Dam compared to Opinion flow and spill targets.

Figure 7. Daily average flow and spill at The Dalles compared to Opinion flow and spill targets.

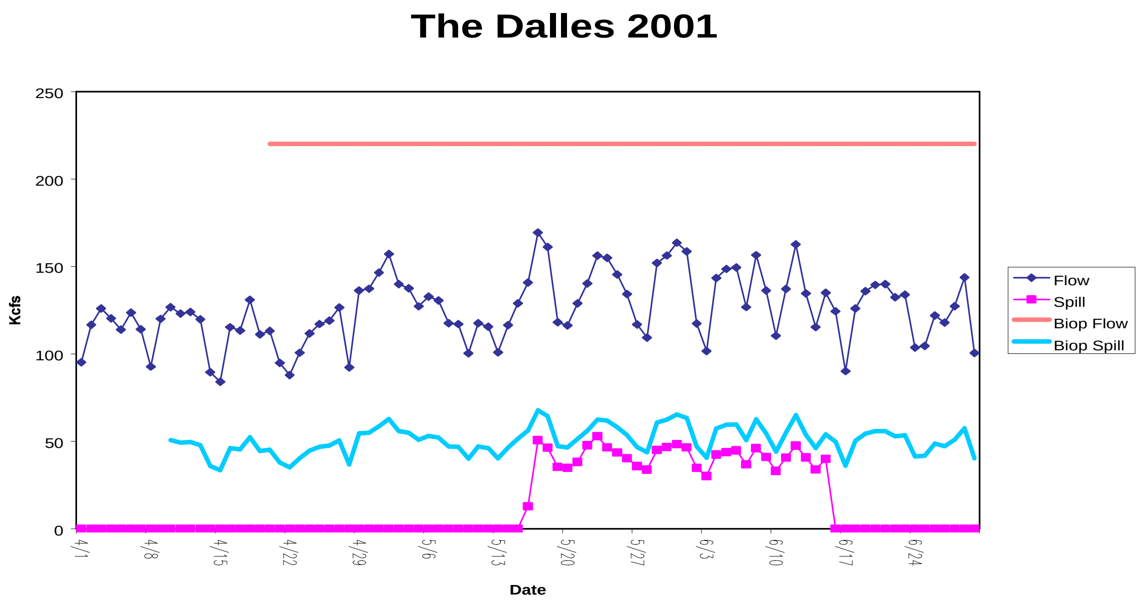
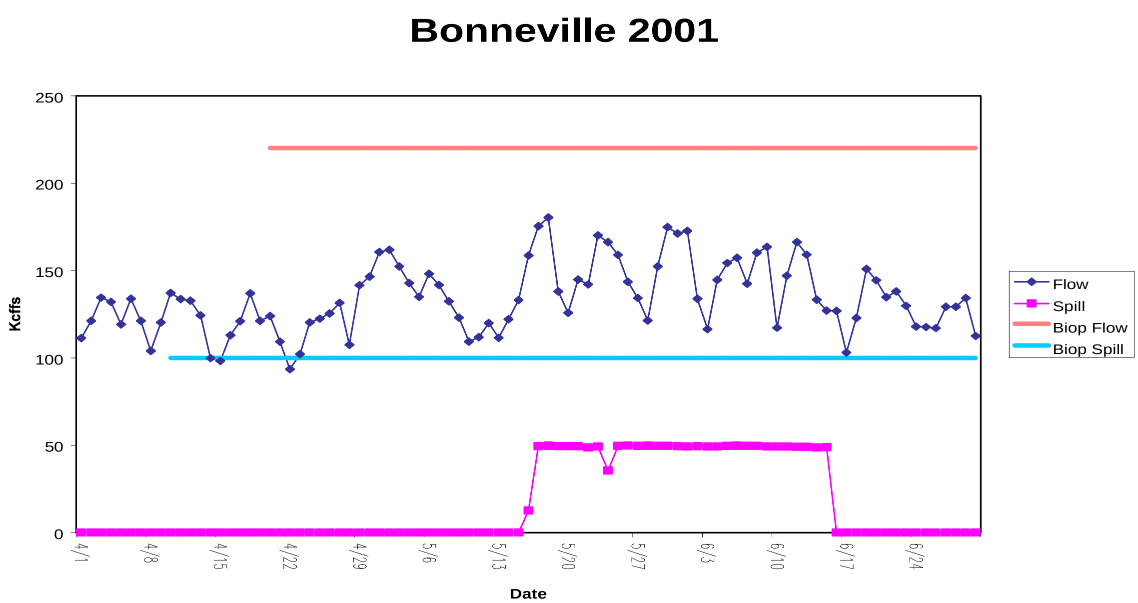


Figure 8. Daily average flow and spill at Bonneville Dam compared to Opinion flow and spill targets.



Survival

We estimated survivals of yearling spring/summer chinook and steelhead, in the reach from Lower Granite tailwater to McNary Dam tailwater, using fish that were PIT-tagged above Lower Granite and subsequently detected at Lower Granite Dam. Fish were grouped in weekly blocks based on date of detection at Lower Granite Dam. Where the sample size of PIT-tagged fish were large enough and standard error of estimates were low enough to generate estimates with reasonable confidence intervals (due in part to recapture probability that was, due to lack of spill, high this season) those estimates were developed and are reported in the graphs and tables below.

Weekly survival estimates for yearling spring\summer chinook were below 60% (about 10% to 15% below normal) in April and declined from mid-May through the remainder of the migration. Estimates of survival by the end of May were lower than 20%. Estimates for both hatchery and wild chinook were very similar. For steelhead survivals began near 20% and declined to less than 10% for hatchery fish, while the wild steelhead seemed to fair only slightly better with survivals that stayed near 20%.

Weighted average seasonal survivals for yearling chinook and steelhead were calculated based on the proportion of fish migrating during each week. For yearling chinook, a season average survival of 0.57 was estimated, and for steelhead 0.16. These season survival estimates are well below the estimates reported for the previous 5 years for migrating juvenile salmonids in the lower Snake River (Table 1 and Figure 13). The steelhead estimate was far below any other seasonal estimate and probably represents both very low survival as well as residualism. In either case the survival of juvenile salmonids was severely impacted by the poor migration conditions in the spring of 2001.

Figure 9. Reach survival estimates from LGR to MCN for hatchery spring/summer chinook.

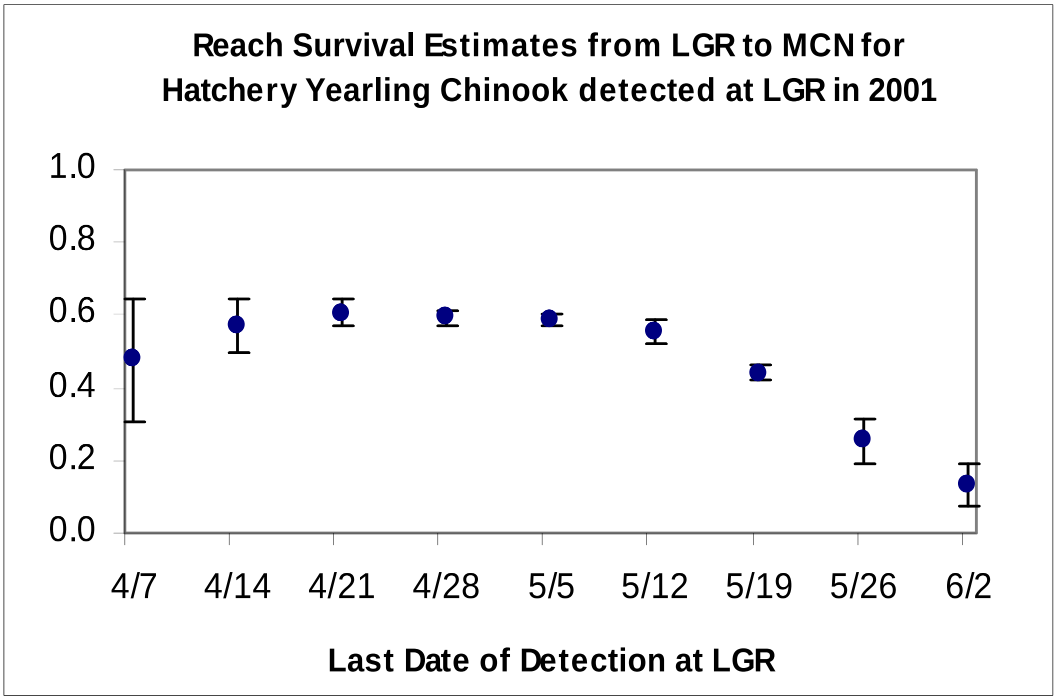


Figure 10. Reach survival estimates from LGR to MCN for hatchery steelhead.

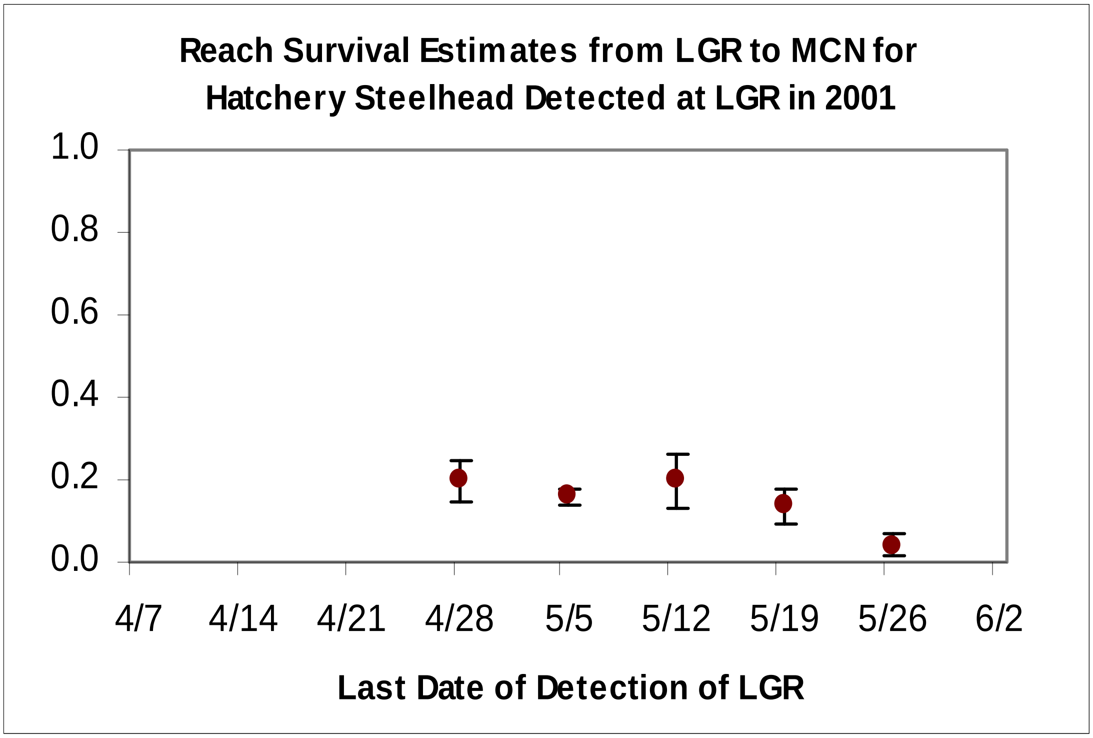


Figure 11. Reach survival estimates from LGR to MCN for wild spring/summer chinook.

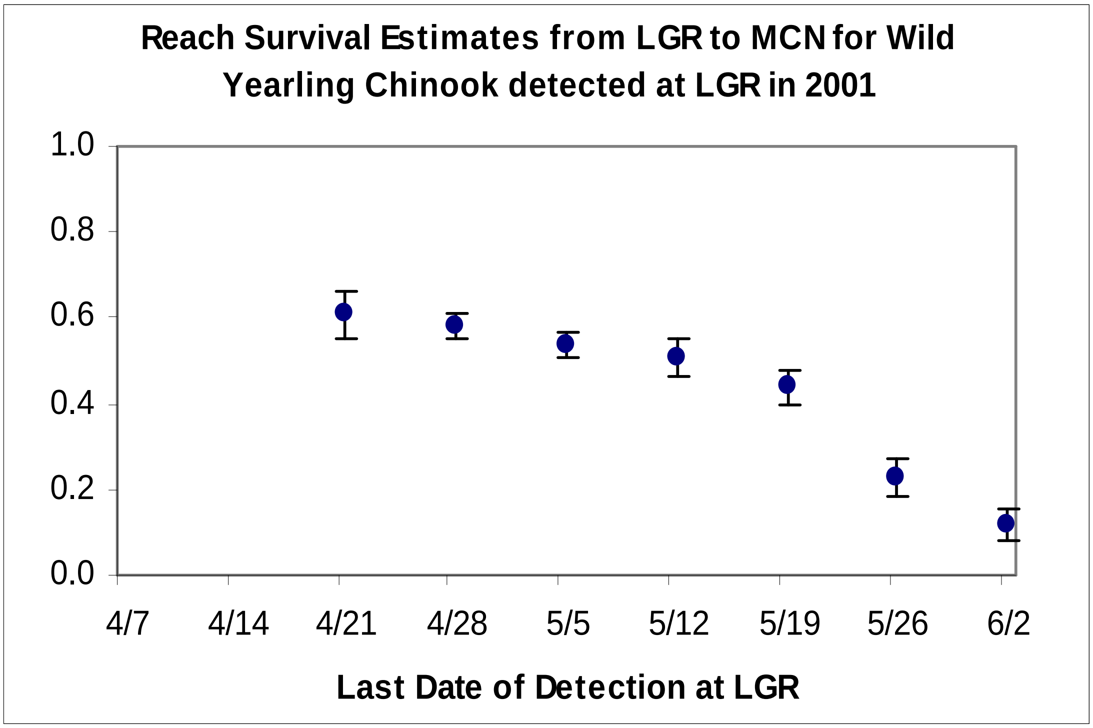


Figure 12. Reach survival estimates from LGR to MCN for wild steelhead.

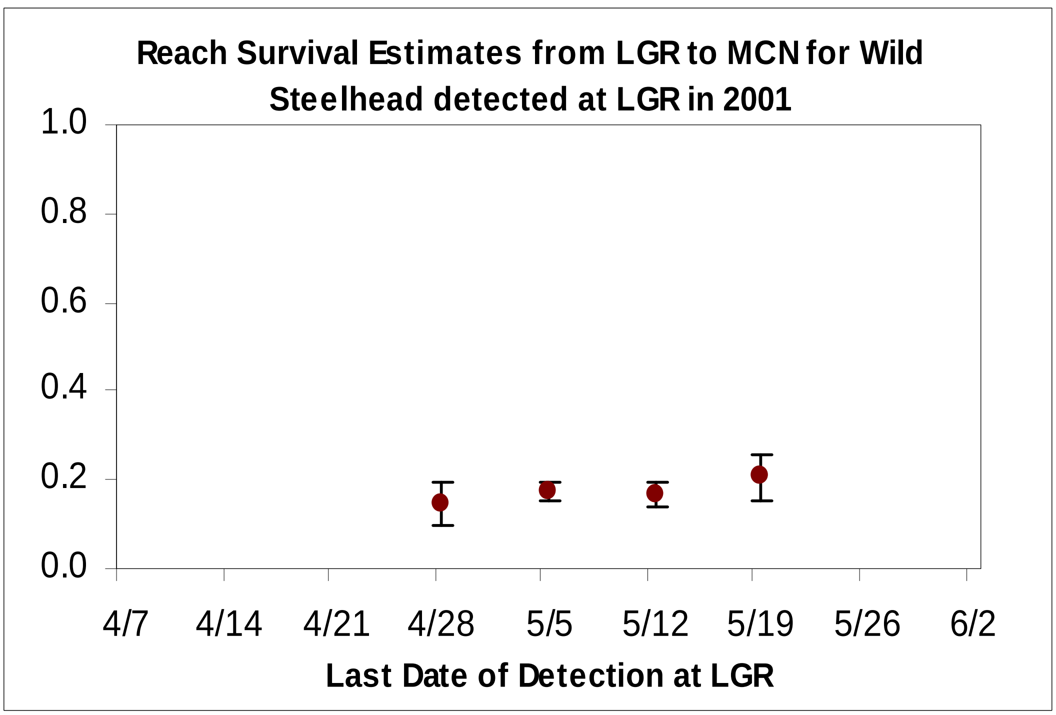


Table 1. Season survival estimates[a] for the reach Lower Granite tailwater to McNary tailwater.

Migration Year	Yearling Chinook	Steelhead
1995	0.72	0.74
1996	0.65	0.69
1997	0.65	0.73
1998	0.77	0.65
1999	0.79	0.69
2000	0.76[b]	
2000	0.74[c]	
2001	0.57[d]	0.16[d]

[a] Estimates from NMFS white paper "Passage of Juvenile and Adult Salmonids Past Columbia and Snake River Dams" unless otherwise indicated.

[b] Estimate by Fish Passage Center includes only wild yearling chinook.

[c] Estimate by Fish Passage Center includes only hatchery yearling chinook from CSS study groups.

[d] Estimates by Fish Passage Center includes hatchery fish only (estimates for wild fish were similar see figures 9 to 12).

Figure 13. Season survival estimates for reach from Lower Granite tailwater to McNary tailwater.

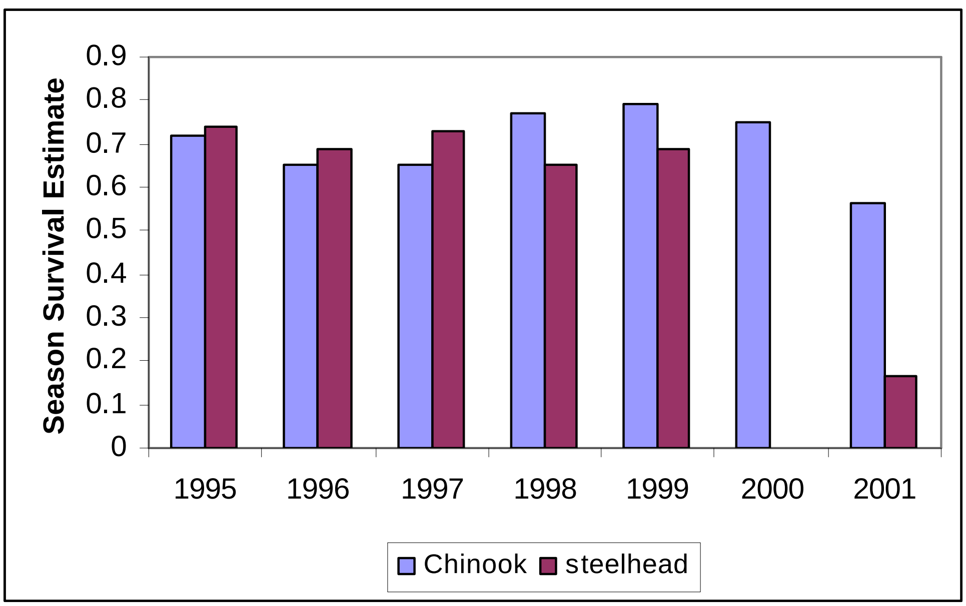


Figure 14. Weekly survival estimates of wild yearling chinook from Lower Granite to McNary dam relative 2001 vs 2000.

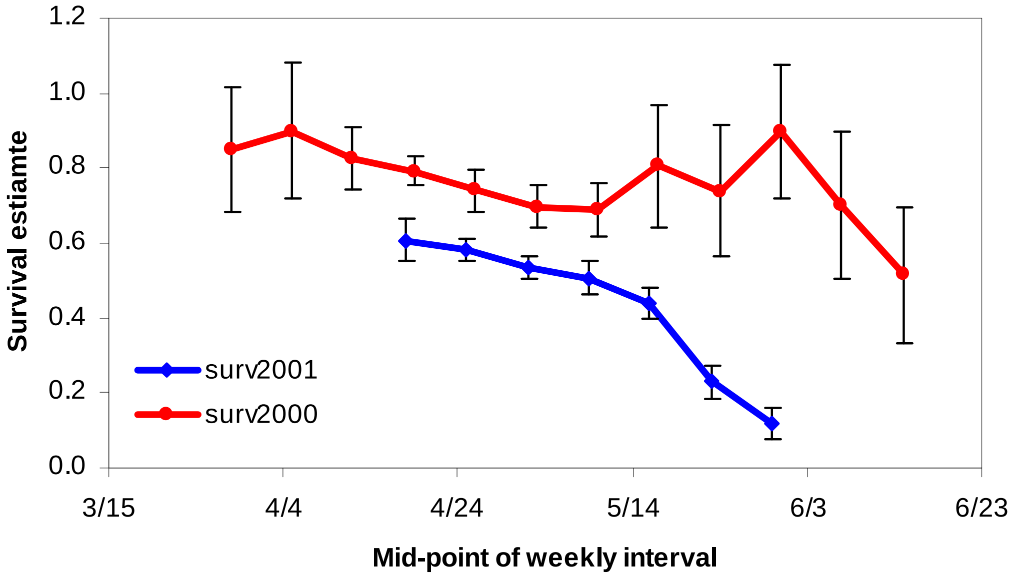
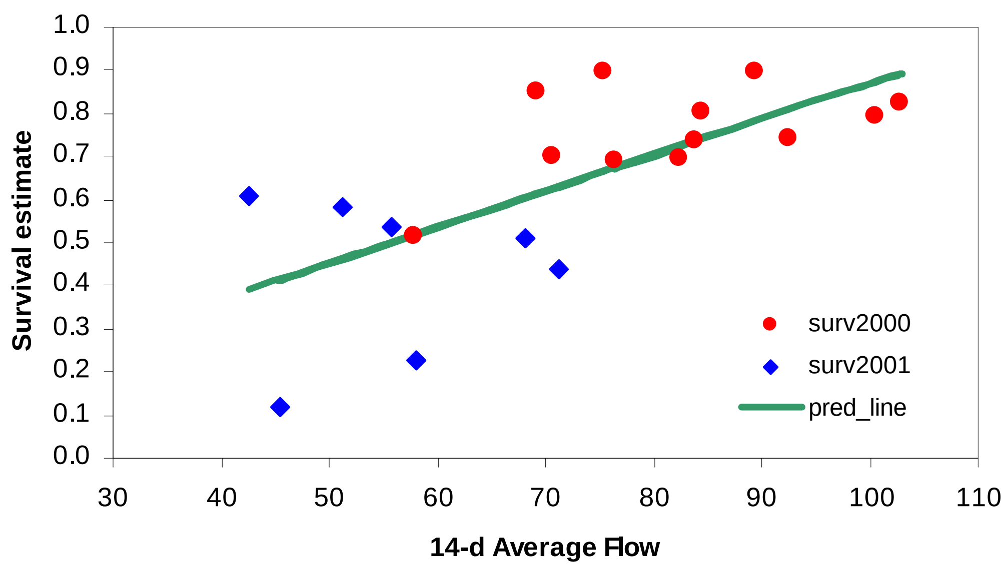


Figure 15. Weekly survival estimates of wild yearling chinook from Lower Granite to McNary Dam tailrace to 14-d average flows 2001 vs 2000.



Weekly survivals were plotted for wild yearling spring chinook through the reach from Lower Granite tailwater to McNary tailwater for the years 2000 and 2001 (Figure 14). The survival estimates in 2001 were significantly lower throughout the season when compared to 2000. For perspective, the 2000 wild yearling chinook season survival rate of 0.76 was near the average of 0.72, for the previous 5 years. In both 2000 and 2001, survivals were highest early in the migration and decreased toward the end of the migration. But in 2001 the late season survivals were obviously much lower than 2000.

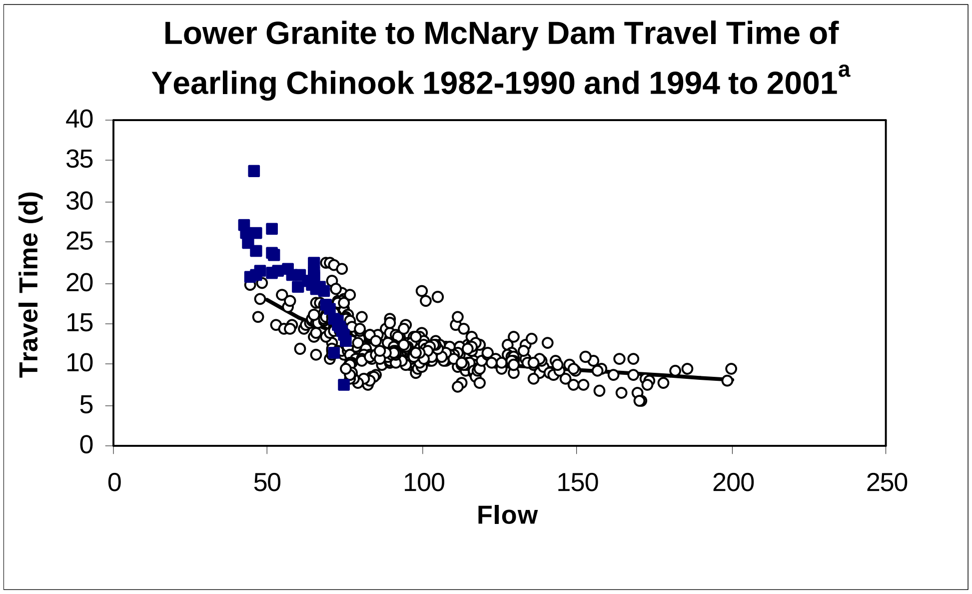
A comparison of survivals, to total discharge, using the same wild chinook data, showed an increase in survival with increasing flows (Figure 15). Flows in the lower Snake River in 2000 were considerably higher than those in 2001. At Lower Granite Dam in 2000, daily average discharge was 84 Kcfs during the month of May, while for the same time period in 2001, flows averaged 64 Kcfs. Weekly survivals were plotted against the 14-day average flows at Lower Granite Dam. Flows were averaged for the time-period beginning on the mid-date of the weekly survival block and extending for two weeks. The 14-d average was considered a representative index of the flow condition each survival block experienced as it passed through the reach. Based on this flow index, it was apparent that 2001 migrants generally experiencing much lower average flows than 2000 migrants, and that lower survivals in 2001, were strongly associated with these lower flows. Only the last weekly estimate for 2000 falls within the range of the 2001 survival estimates and that was during a period with the lowest flows in 2000 but similar to those seen at the peak of the 2001 migration.

Travel time

We calculated travel times for yearling spring\summer chinook and steelhead for two reaches: from Lower Granite to McNary Dam and from McNary to Bonneville Dam. We grouped migrants by date of detection at the upriver project and calculated travel times for all fish detected at the downriver project. We included all travel times between the 10% and 90% passage dates at the upriver project, where greater than 10 fish were observed. In most cases, for 2001, we had more than 50 fish per date, and on some dates over 1000 fish were used to calculate travel times. Travel times were plotted for 2001 versus data from the past several years for comparison.

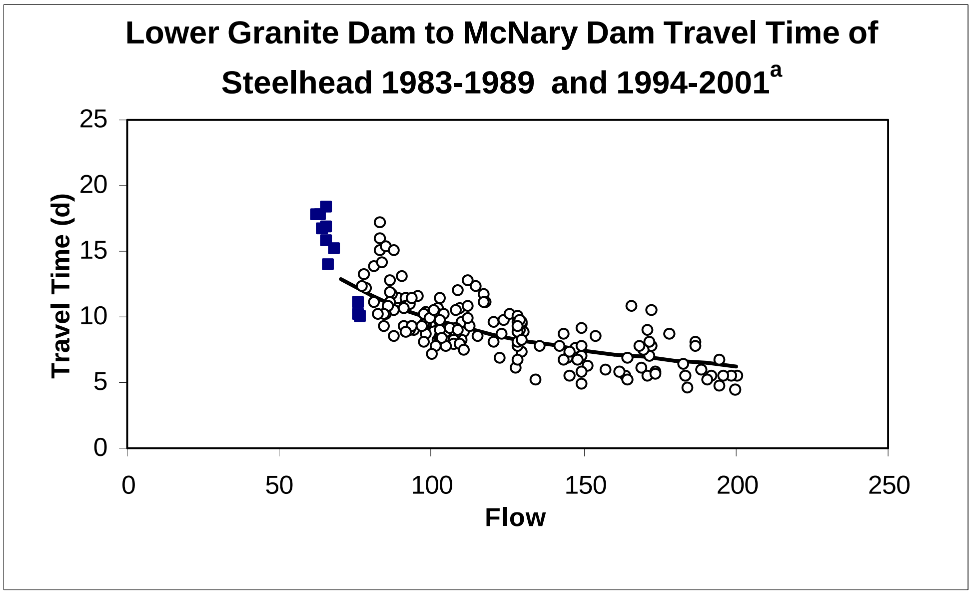
Travel times for the 2001 migration were among the longest seen for both yearling spring\summer chinook and steelhead in comparison to all other years we have been calculating these statistics for Columbia and Snake River fish (see figures 16 through 19). The unusually long travel times were especially noticeable in the Lower Columbia, where flows were near record lows. For yearling chinook over the years 1996 to 2000, travel time from McNary Dam to Bonneville Dam averaged 5.6 days (average and of median daily travel times) while for 2001 travel times average 10.8 days. For steelhead over the same reach the 1996 to 2000 average travel time was 5.0 days compared to an average of 10.0 for 2001.

Figure 16. Comparison of 2001 travel times of yearling spring/summer chinook from LGR to MCN to historic data.



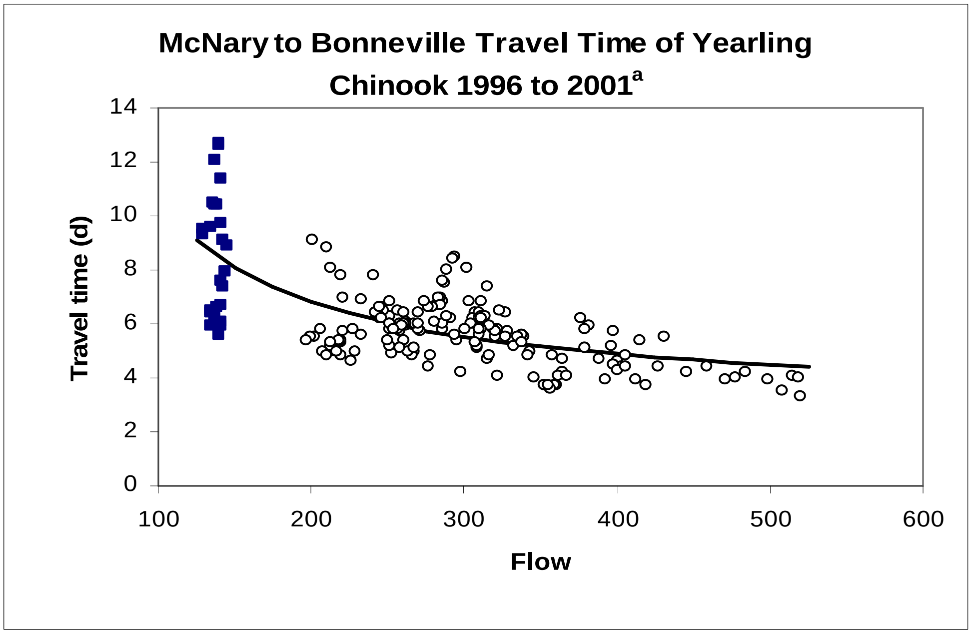
[a] 2001 data shown as solid squares.

Figure 17. Comparison of 2001 travel times of steelhead from LGR to MCN to historic data.



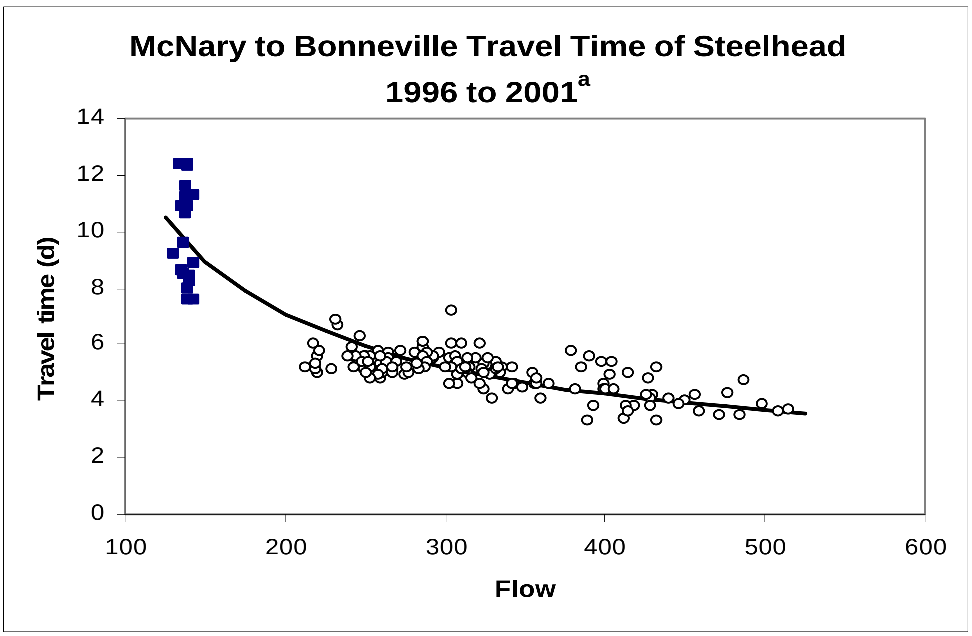
[a] 2001 data shown as solid squares.

Figure 18. Comparison of 2001 travel times of yearling spring/summer chinook from MCN to BON to historic data.



[a] 2001 data shown as solid squares.

Figure 19. Comparison of 2001 travel times of steelhead from MCN to BON to historic data.



[a] 2001 data shown as solid squares.

Migration Timing

The time period of the spring outmigration past Lower Granite Dam this season was not greatly different when compared to historic timing. However, for both yearling spring\summer chinook and steelhead, the run began later than normal and was of shorter duration when comparing 10% and 90% passage dates to historic averages (Tables 2 and 3). This suggests that the migration was slow to develop due to low flows and that survival to Lower Granite was lower, so that the migration ended earlier despite slower travel times. This truncation of passage is likely due to increased mortality in the case of chinook, while it may well be due to both mortality and residualism in steelhead.

Table 2. Migration Timing of yearling spring/summer chinook at Lower Granite Dam.

	10% Passage	**50% Passage**	**90% Passage**	**Days for mid-80% passage**
Avg 1985 to 2000	4/18	5/1	5/19	31
2001	4/26	5/5	5/18	22
Difference	+8	+4	-1	-9

Table 3. Migration Timing of steelhead at Lower Granite Dam.

	10% Passage	**50% Passage**	**90% Passage**	**Days for mid-80% passage**
Avg 1985 to 2000	4/26	5/9	5/28	32
2001	4/29	5/10	5/26	27
Difference	+3	+1	-2	-5

In the middle of the spring outmigration there was a large drop in daily flows (from 68 Kcfs on 5/1 down to 43 Kcfs on 5/7). This drop in flows was accompanied by a drop in daily passage index of yearling spring/summer chinook from a peak of 155,000 on 5/1 to 18,000 on 5/8 and for steelhead a peak of 346,000 on 5/2 down to 60,000 on 5/8. The flows then increased to 90 Kcfs on 5/17 and coincident with this there was a second peak in the chinook passage index at 141,000 on 5/15 and a similar peak for steelhead at 388,000 on 5/18 (Figures 20 and 21). The drop in flows had the apparent effect of delaying the migration at a time when passage was peaking in the lower Snake River.

Figure 20. Passage timing of yearling chinook versus flows at Lower Granite Dam.

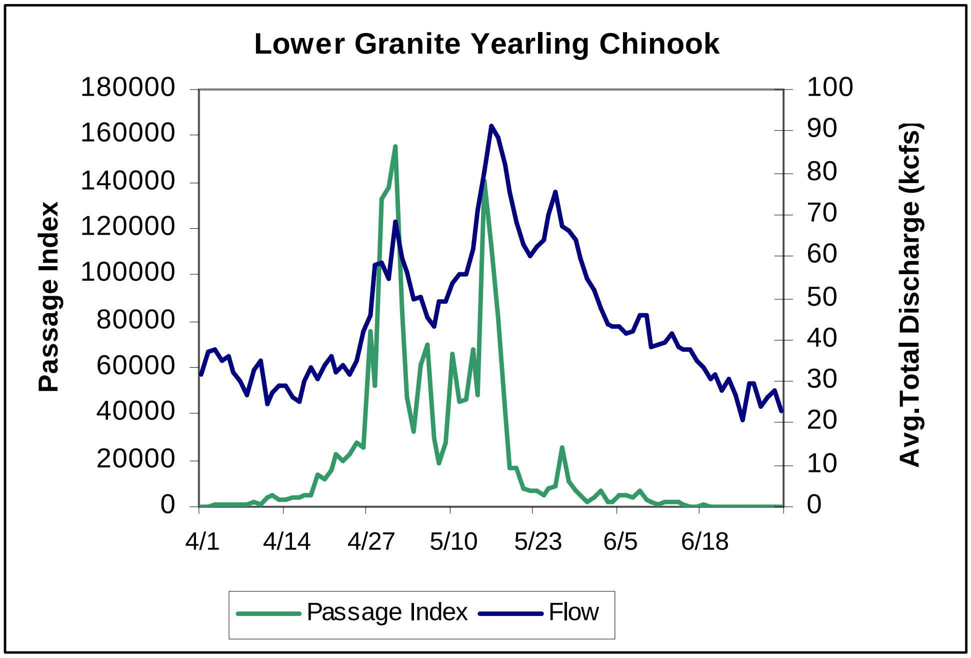
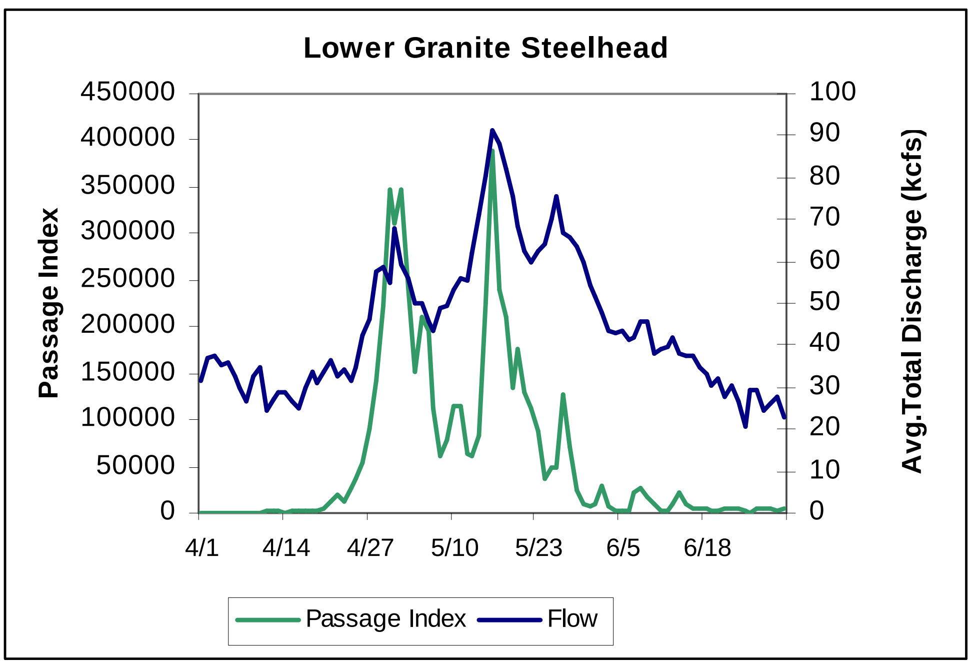


Figure 21. Passage timing of steelhead versus flows at Lower Granite Dam.



We generated seasonal total collections of migrants past Lower Granite, McNary, Rock Island, and Bonneville dams. In most cases we based the season total projected passage index upon NMFS estimates of total collection at those sites for each species. We then fitted the historic cumulative run-timing curves to these expected totals by adjusting cumulative daily proportions to an expected final total. The plots then provide an historic timing curve fitted to the magnitude of this year's expected outmigration. We then plot daily indices, in season, against the historic curve to be able to compare this season's migration timing and magnitude to both historic timing and projected magnitude (see Figures 22 and 23). Caution should be used in comparing actual in-season passage indices to preseason projections, since there can be some difficulty in determining the exact size of a run and subsequent collection past a particular dam any given year. However, the comparison can be quite useful for comparing timing and to some degree the magnitude of the run.

As indicated by the 10% and 90% passage dates described in table 2, at Lower Granite Dam the yearling spring/summer chinook migration began more slowly than historic average. In the cumulative graph (Figure 22), the 2001 data (in these plots the red line) appears below the historic curve and outside the 95% confidence interval; an indication that the spring migration began late at this site. The steelhead show a similar pattern (Figure 23) with the run beginning later than historic timing. Also, both graphs show a steep ascending portion that indicates large numbers passing each day during the height of the migration. In both chinook and steelhead this is interrupted by a period where the slope of the curve flattens out. The changes in slope coincide with decreasing numbers of fish passing the dam at a time period of low flows that occurred in the middle of the migration (this was discussed earlier in run-timing portion of document. For comparison see figures 20 and 21). The lowest flows occurred near May 8 coinciding with the change in slope of the cumulative curves.

Figure 22. Cumulative passage index graph for yearling spring/summer chinook at Lower Granite Dam.

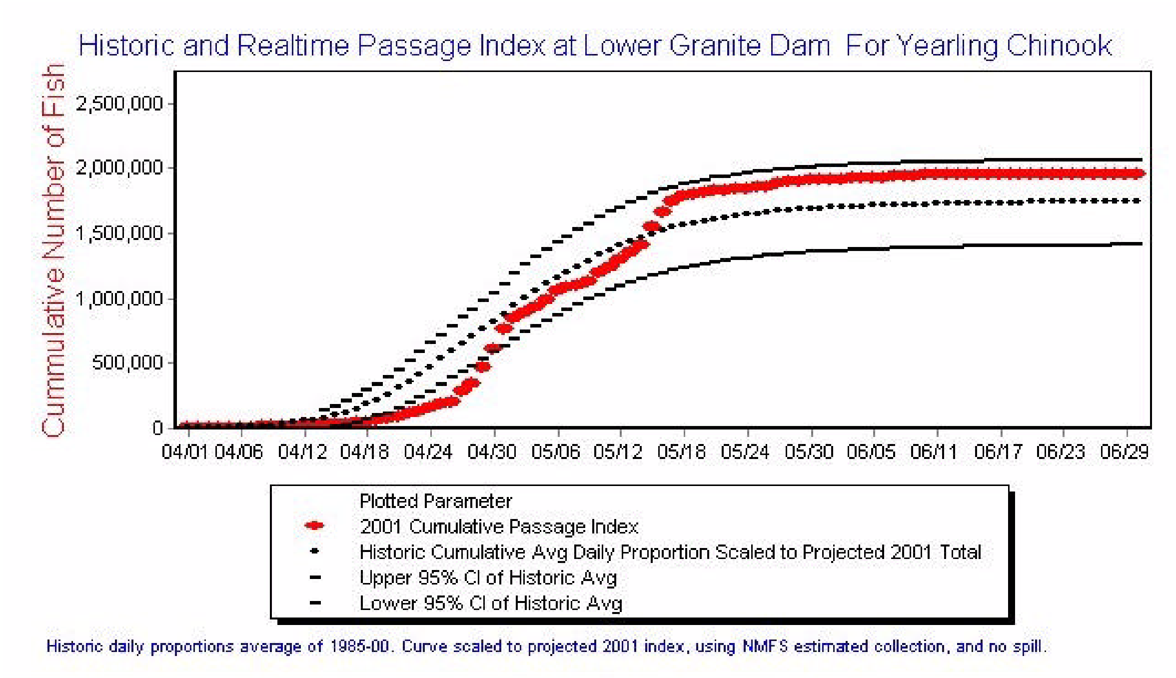
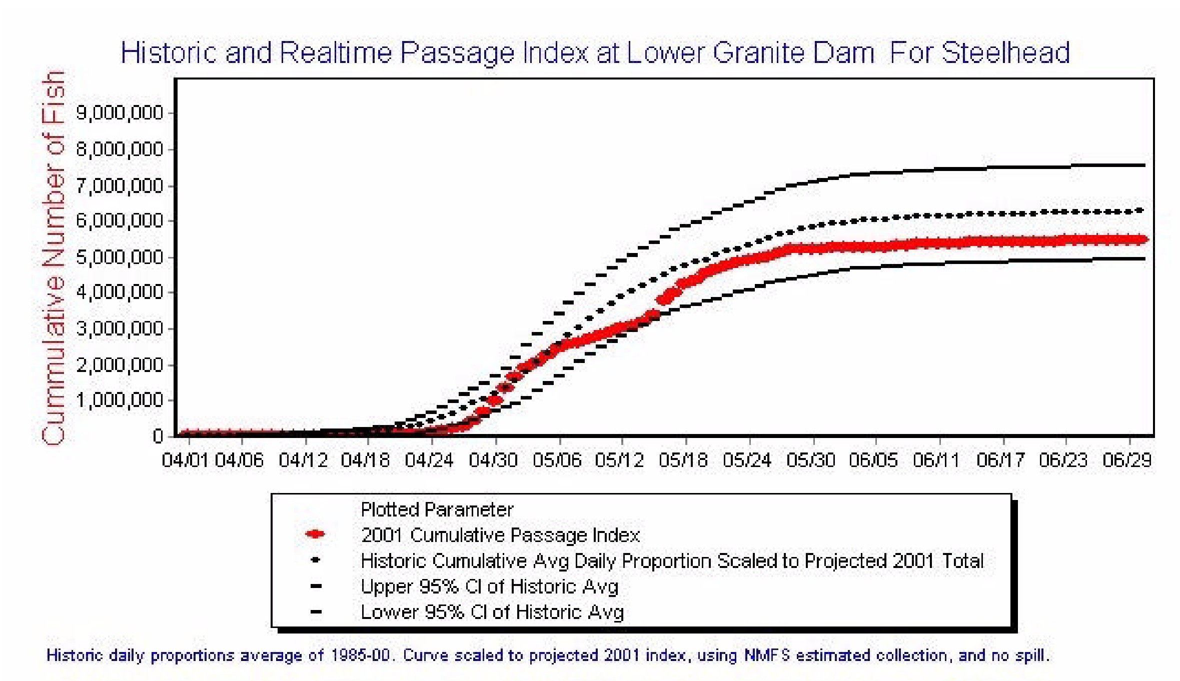


Figure 23. Cumulative passage index graph for steelhead at Lower Granite Dam.



The timing of passage for spring migrants at McNary was more delayed compared to the average historic dates for yearling chinook (Table 4). The chinook run began 18 days later than the historic average as fish appeared to be held up by low flows. Daily average flows averaged 107 Kcfs at McNary in April of 2001 and 123 Kcfs in May compared to 252 Kcfs in April of 2000 and 256 in May. The delayed timing of the yearling chinook outmigration shows up quite distinctly in the cumulative passage plot (Figure 26). A spike in flows over 150 Kcfs around 5/23 coincided with increased numbers of chinook passing the project (Figure 24). The high passage numbers (average 106,000/day) continued until the first week of June. But flows declined during this time period and then dropped to 106 Kcfs on June 3. From that date on the numbers passing declined. For both steelhead and chinook the timing of the 90% passage was more than a week later than average. But the steelhead migration never reached the numbers we projected for total cumulative passage. Although the 10% passage date was the same as historic dates, the 50% and 90% passage dates were later than historic averages, indicating that the run was more protracted than historic average. Considering travel times we calculated for steelhead in the lower Columbia it is likely that this extended passage timing was due to slower rates of migration.

Table 4. Migration Timing of yearling spring/summer chinook at McNary Dam.

	10% Passage	**50% Passage**	**90% Passage**	**Days for mid-80% passage**
Avg 1985 to 2000	4/23	5/11	5/27	34
2001	5/11	5/26	6/7	27
Difference	+18	+15	+11	-7

Table 5. Migration Timing of steelhead at McNary Dam.

	10% Passage	**50% Passage**	**90% Passage**	**Days for mid-80% passage**
Avg 1985 to 2000	4/27	5/15	6/1	35
2001	4/27	5/22	6/9	43
Difference	0	+7	+8	+8

Figure 24. Passage timing of yearling chinook versus flows at McNary Dam.

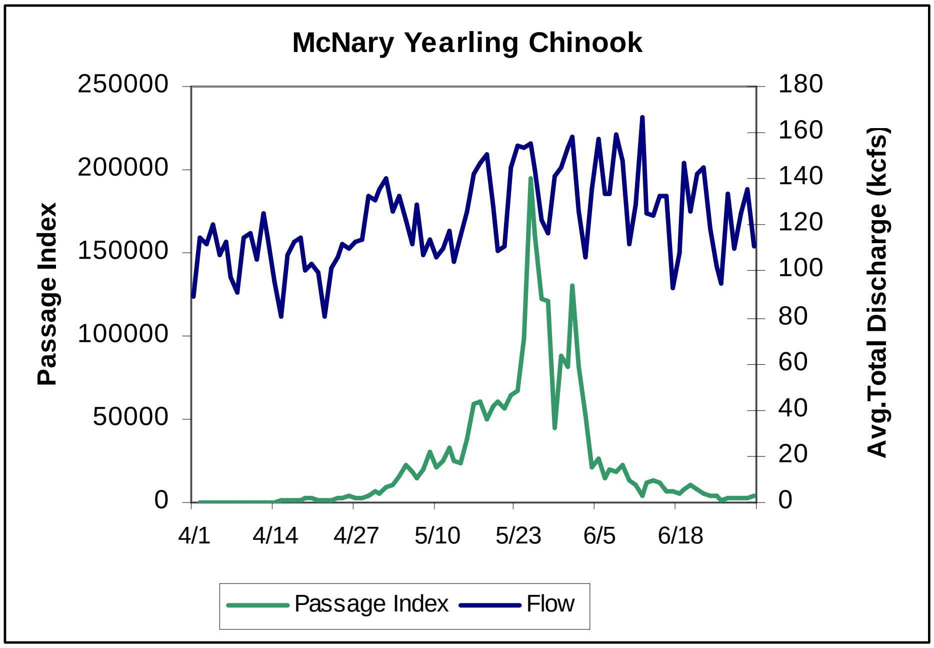


Figure 25. Passage timing of steelhead versus flows at McNary Dam.

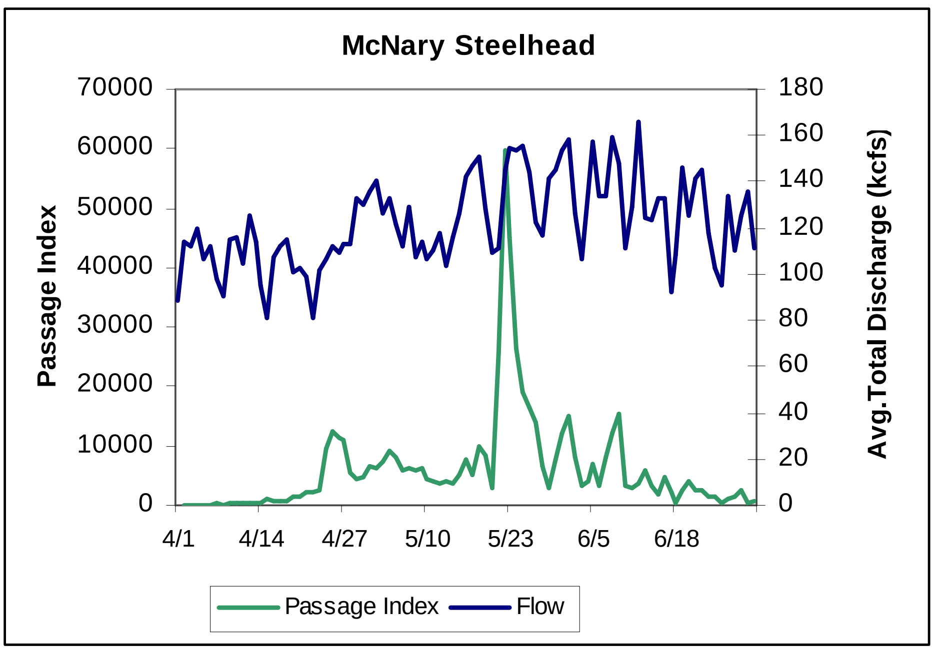


Figure 26. Cumulative passage index graph for yearling chinook at McNary Dam.

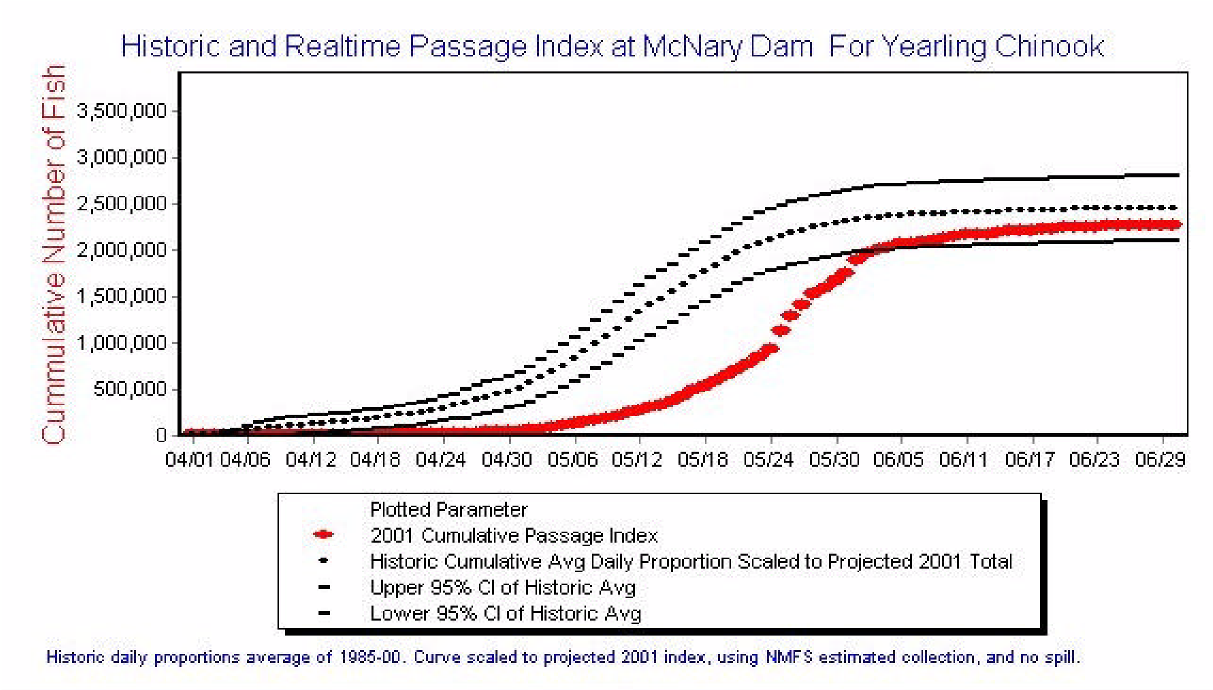
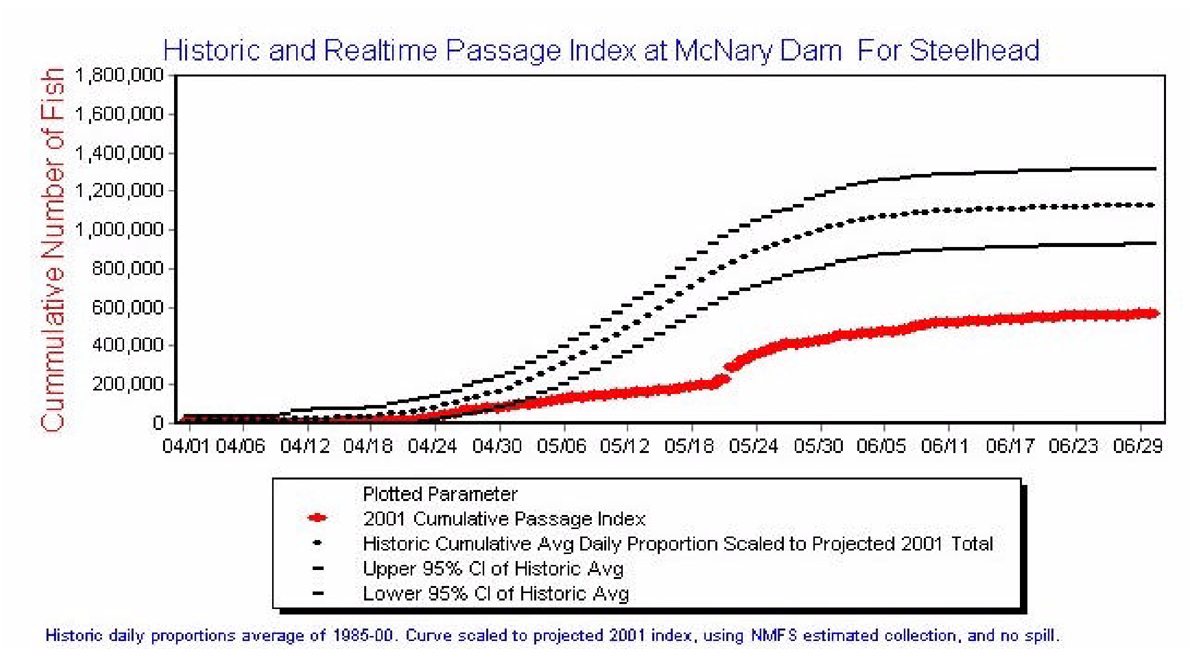


Figure 27. Cumulative passage index graph for steelhead at McNary Dam.



At Bonneville the Spring migration was later than historic passage (Tables 6 and 7). For both yearling chinook and steelhead the 10% passage date was 6 days later than average, and the 90% passage date was 10 d later. The lateness of passage timing at Bonneville Dam not surprising given the late timing of the migration at up-river projects. Also, this late timing may be explained in part, by the doubling of average travel times in 2001 for both chinook and steelhead versus historic travel times in the reach from McNary Dam to Bonneville Dam.

Table 6. Migration Timing of yearling spring/summer chinook at Bonneville Dam.

	10% Passage	50% Passage	90% Passage	Days for mid-80% passage
Avg 1985 to 2000	4/20	5/6	5/27	37
2001	4/26	5/19	6/6	41
Difference	+6	+13	+10	+4

Table 7. Migration Timing of steelhead at Bonneville Dam.

	10% Passage	50% Passage	90% Passage	Days for mid-80% passage
Avg 1985 to 2000	4/28	5/17	5/31	33
2001	5/4	5/19	6/10	37
Difference	+6	+2	+10	+4

While it is clear low flow contributed to increase travel times, flows in the lower Columbia also fluctuated widely over short periods of time. For example flows went from 162 on 5/2 to 109 on 5/10, then to 180 on 5/18 then down to 125 on 5/20 and back to 170 on 5/23; these fluctuations represent a change of 30 to 40% in total river flow. While these sorts of fluctuations might be expected to occur throughout the season, over such a short time period, it is questionable what effects these might have on migrating smolts. It is evident from weekly peaks in passage indices that steelhead were more affected by this type of flow fluctuation than chinook (compare Figure 28 to Figure 29).

Figure 28. Passage timing of yearling chinook versus flows at Bonneville Dam.

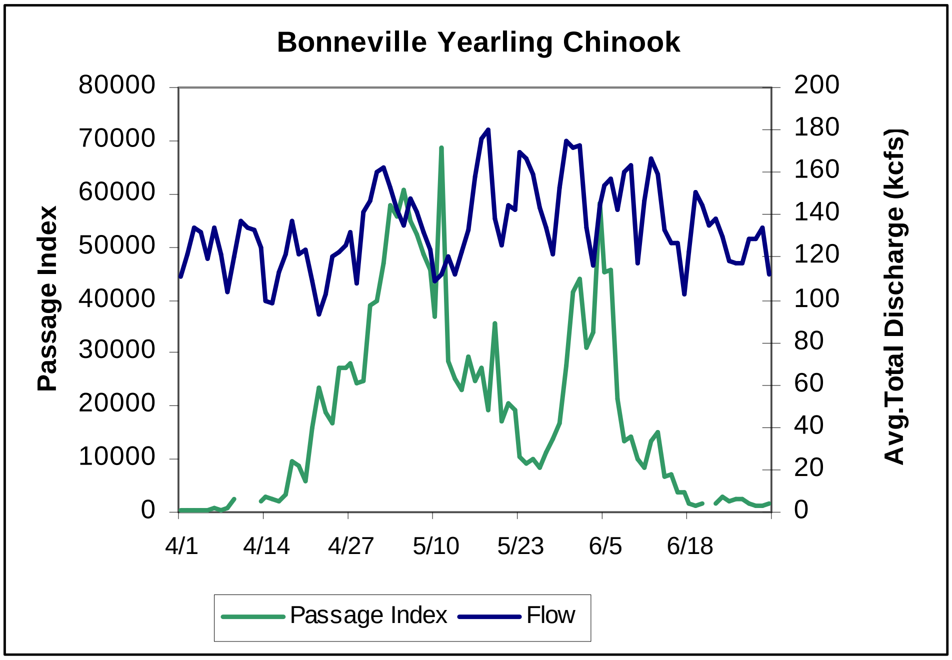


Figure 29. Passage timing of steelhead versus flows at Bonneville Dam.

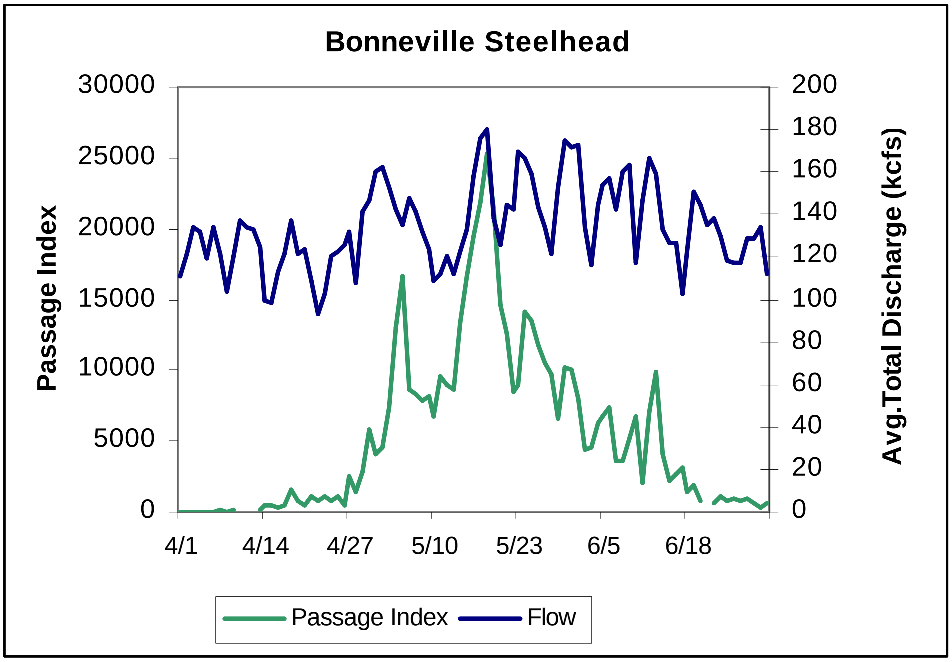


Figure 30. Cumulative passage index graph for yearling chinook at Bonneville Dam.

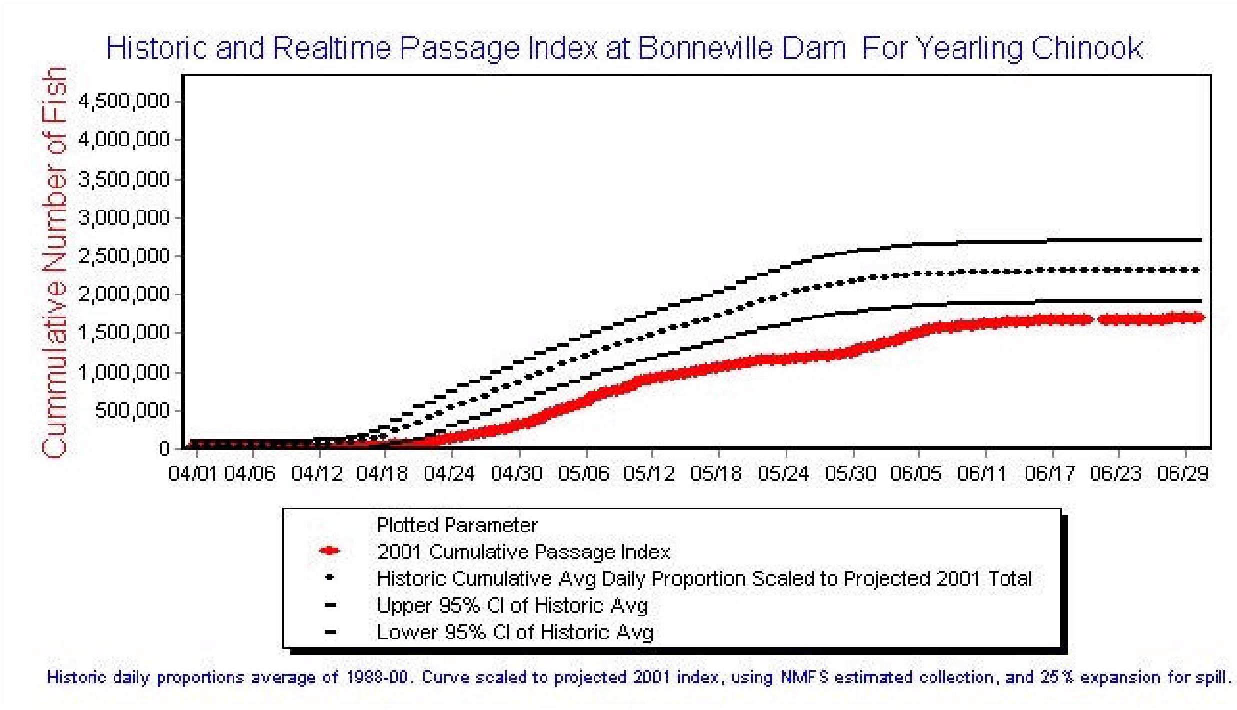
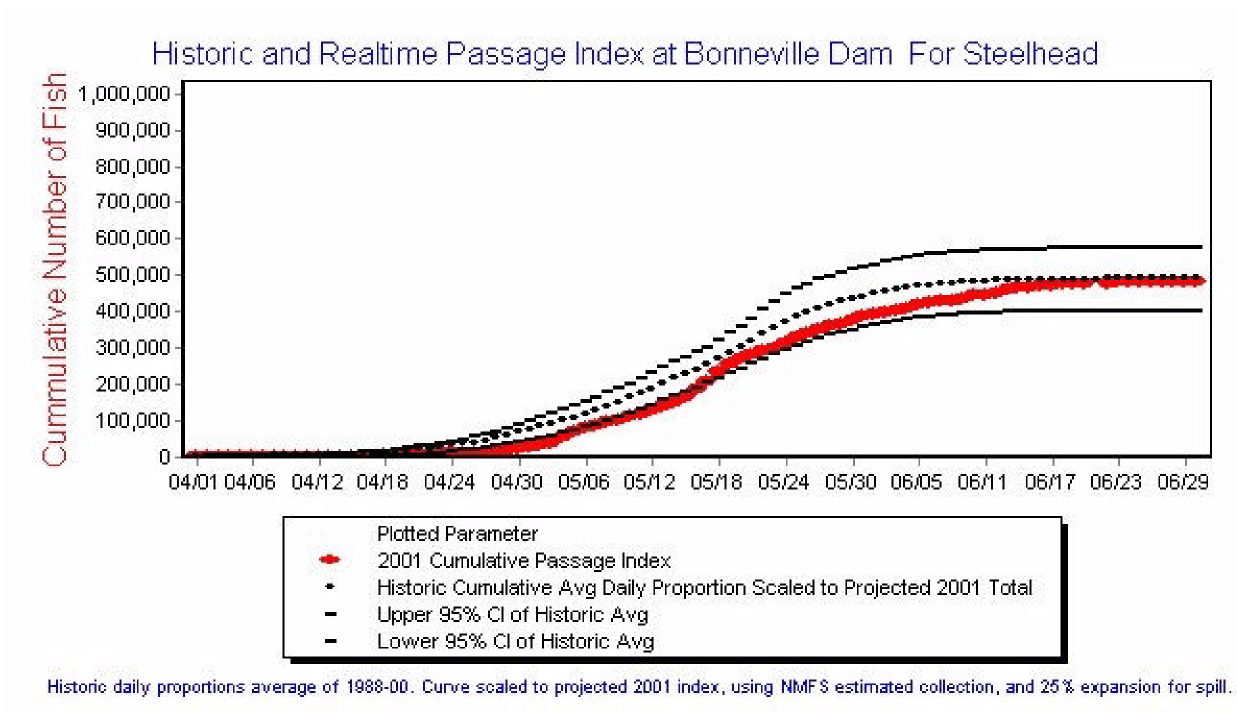


Figure 31. Historic & Realtime for Steelhead at Bonneville Dam.



The mid-Columbia out-migration was shaped by the cyclic peaking of flows that followed the artificial weekly cycle of power needs. Flows out of Grand Coulee followed a weekly pattern, with low flows on Saturday and Sunday, and higher flows Monday through Friday. At Rock Island Dam passage timing of yearling chinook was earlier than historic 10%-90% passage dates.

Table 8. Migration Timing of yearling spring/summer chinook at Rock Island Dam.

	10% Passage	50% Passage	90% Passage	Days for mid-80% passage
Avg 1985 to 2000	4/23	5/12	6/1	39
2001	4/20	5/5	5/30	40
Difference	-3	-7	-2	+1

Table 9. Migration Timing of steelhead at Rock Island Dam.

	10% Passage	50% Passage	90% Passage	Days for mid-80% passage
Avg 1985 to 2000	5/2	5/15	6/1	30
2001	5/11	5/26	6/16	36
Difference	+9	+11	+15	+6

But in the case of yearling chinook the run never seemed to get started despite the sudden spike in the passage index of 867 on 4/20 that coincided with flows that had risen from 35 Kcfs on 4/15 to 75 on 4/17 (Figure 32). The higher flows lasted only until 4/20; on 4/21 flows dropped to 43 Kcfs and the passage index also began dropping reaching a nadir of 85 on 4/24. Again flows pushed upward cycling up to a high of 77 on 4/24 again fish passage responded and the index reached another peak of 295 on 4/26. This cycling of flow and passage index peaks occurred several times during the spring (Figures 32 and 33). Steelhead passage indices showed similar, but more pronounced weekly spikes during the peak of their migration past Rock Island Dam (Figure 33).

Figure 32. Passage timing of yearling chinook versus flows at Rock Island Dam.

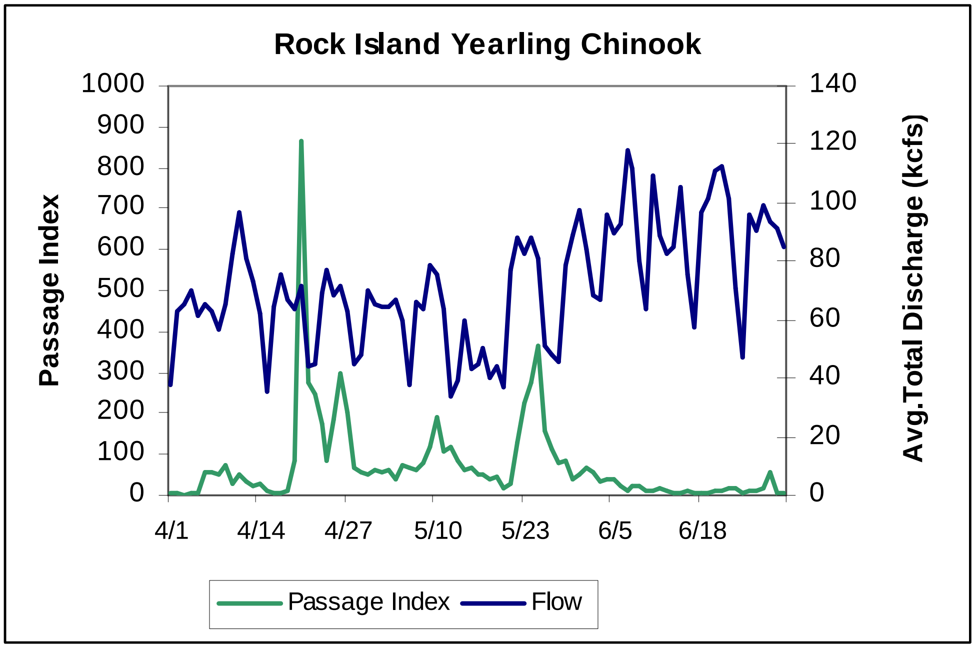
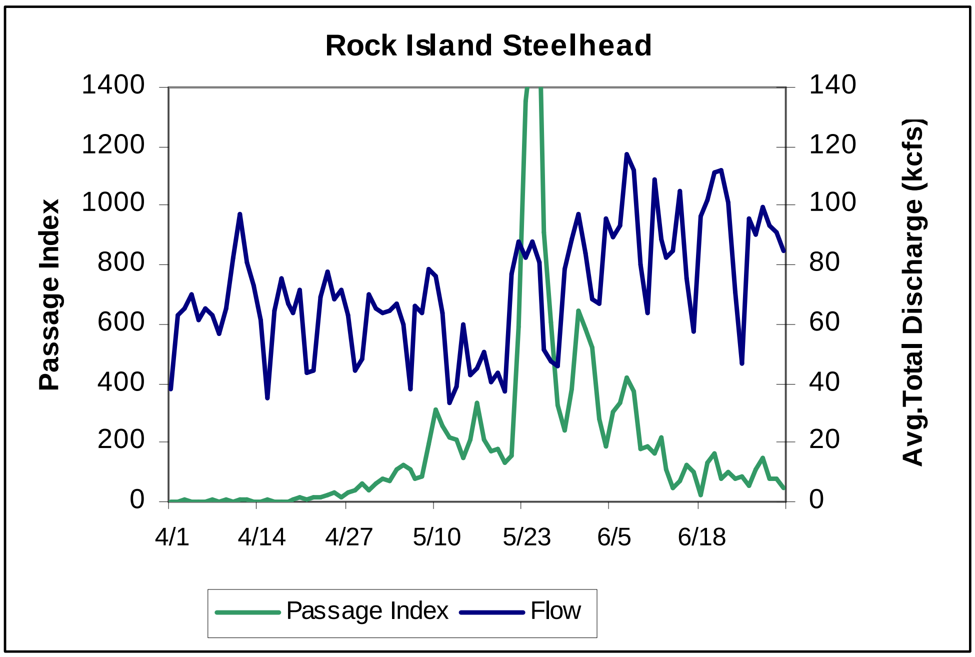


Figure 33. Passage timing of steelhead versus flows at Rock Island Dam.



Conclusions

Near record low flows produced poor migration conditions for juvenile salmonids this spring. NMFS flow targets were never met and the spill program was implemented at a fraction of Opinion levels. The combination of low spill and low flows resulted in very poor survivals and travel times for juvenile migrants.

Survival estimates for the reach from Lower Granite Dam to McNary Dam were the lowest since estimation using PIT-tags was begun, in 1993. Travel times for chinook and steelhead were longer than most historic values for the Snake River; and in the lower Columbia travel times doubled the historic average.

APPENDIX B

Total Dissolved Gas Saturation Plots

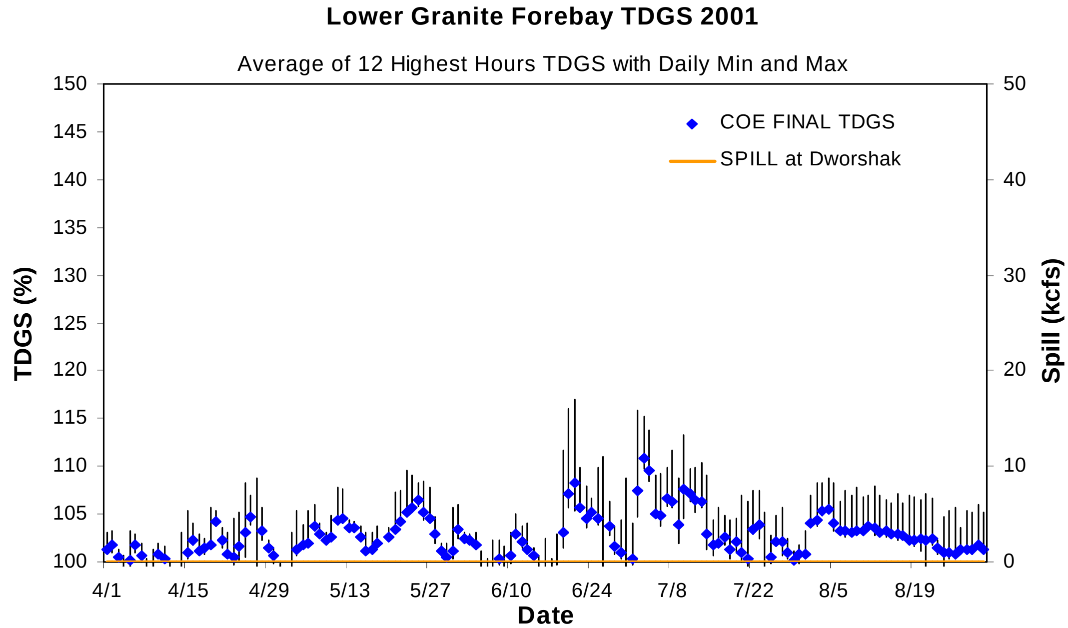


FIGURE B-1. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Forebay.

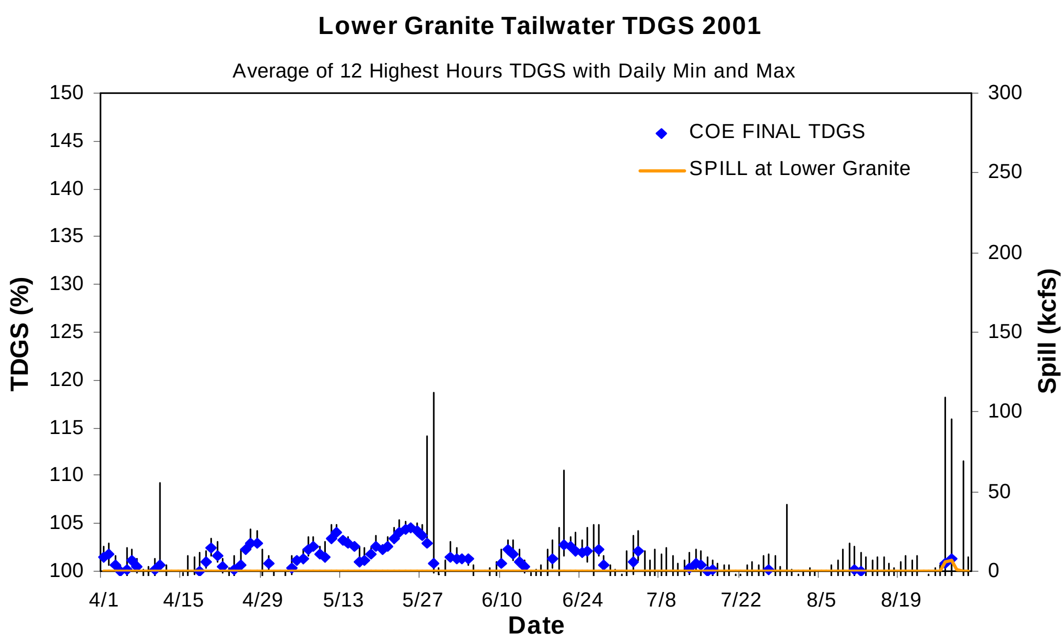


FIGURE B-2. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Tailwater.

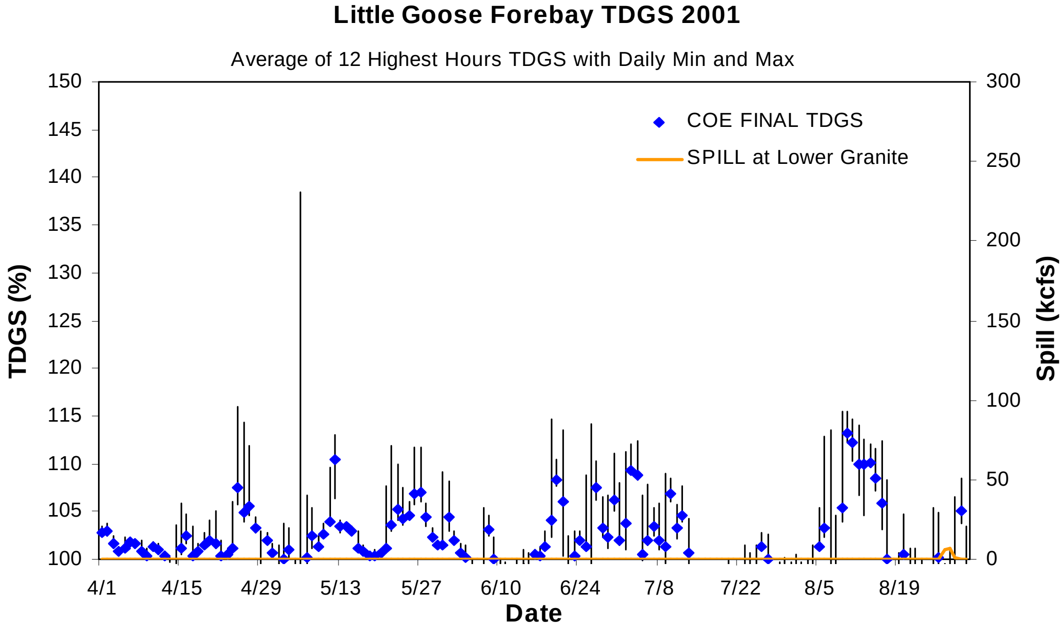


FIGURE B-3. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Forebay.

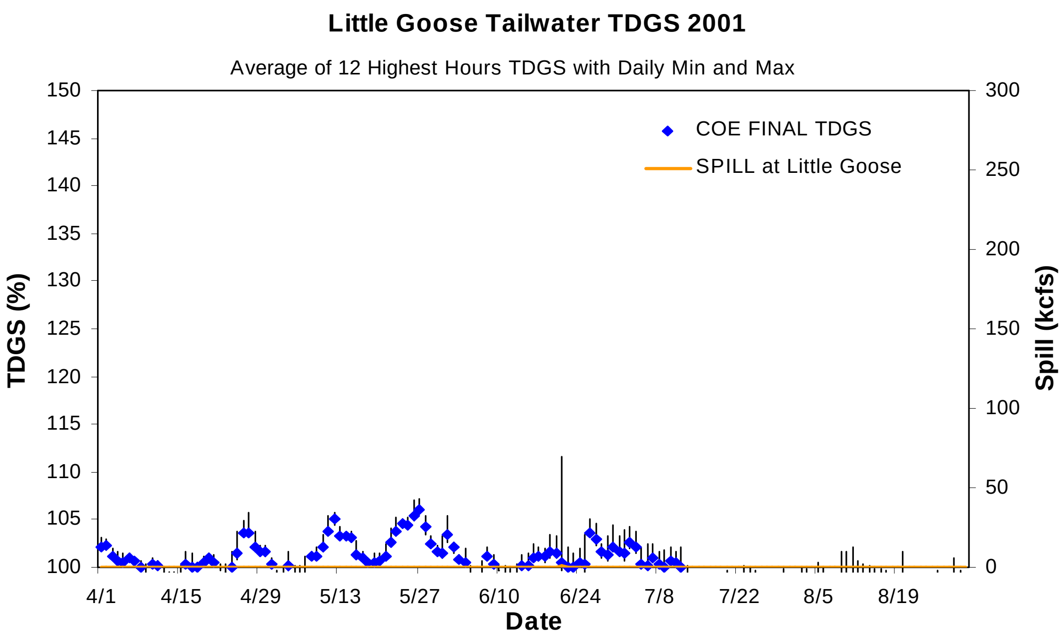


FIGURE B-4. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Tailwater.

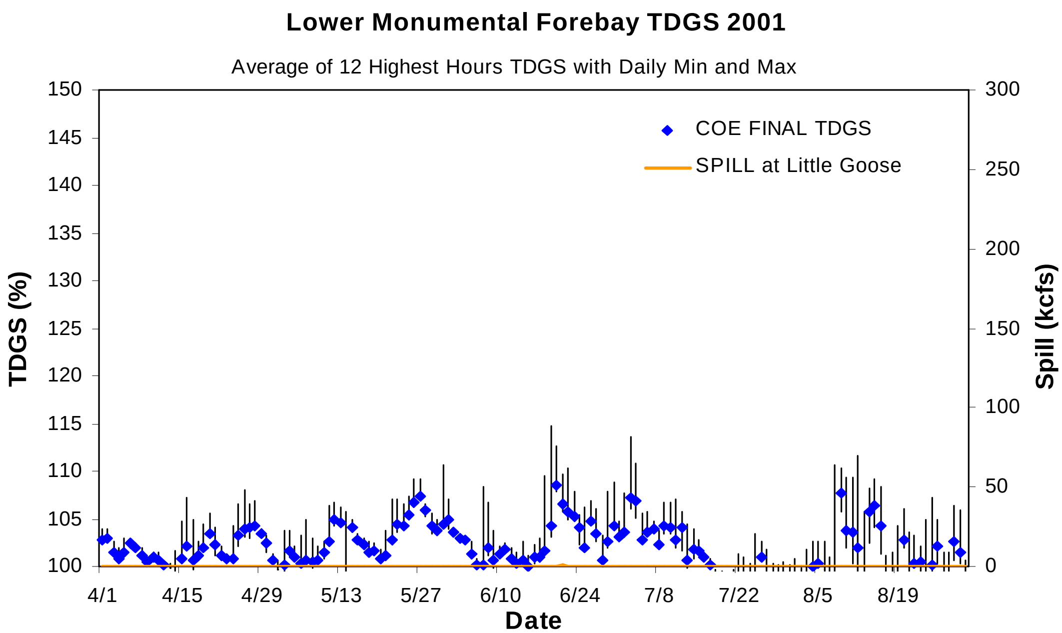


FIGURE B-5. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Forebay.

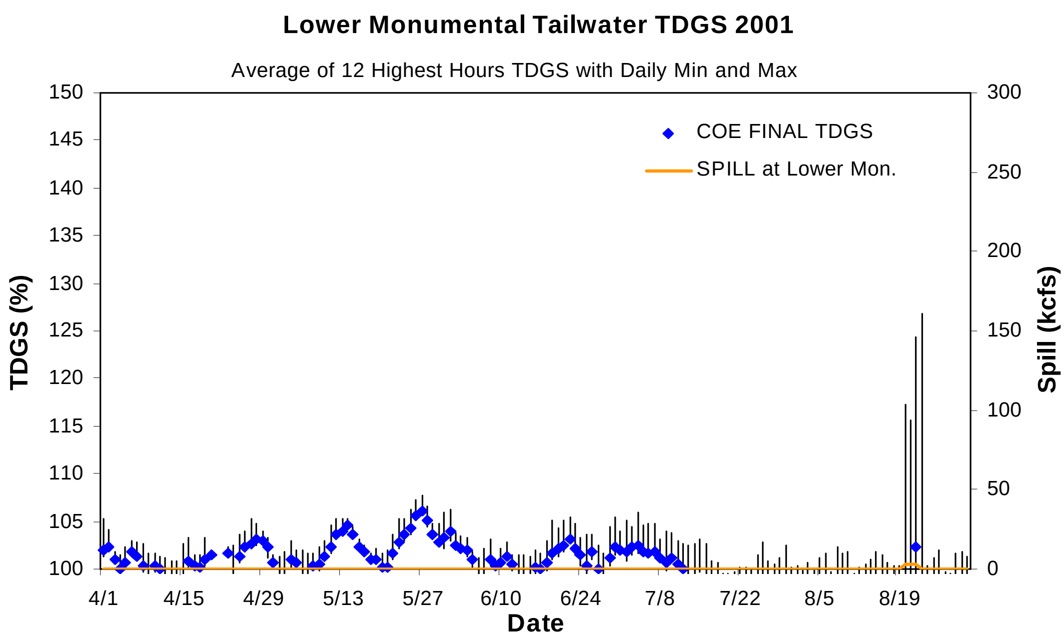


FIGURE B-6. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Tailwater.

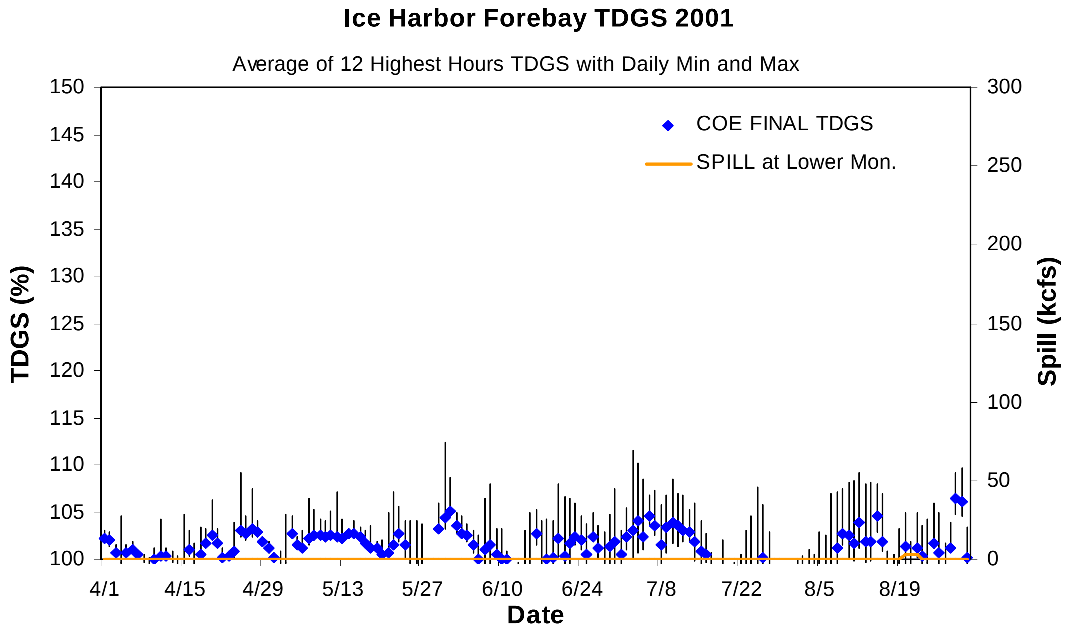


FIGURE B-7. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Forebay

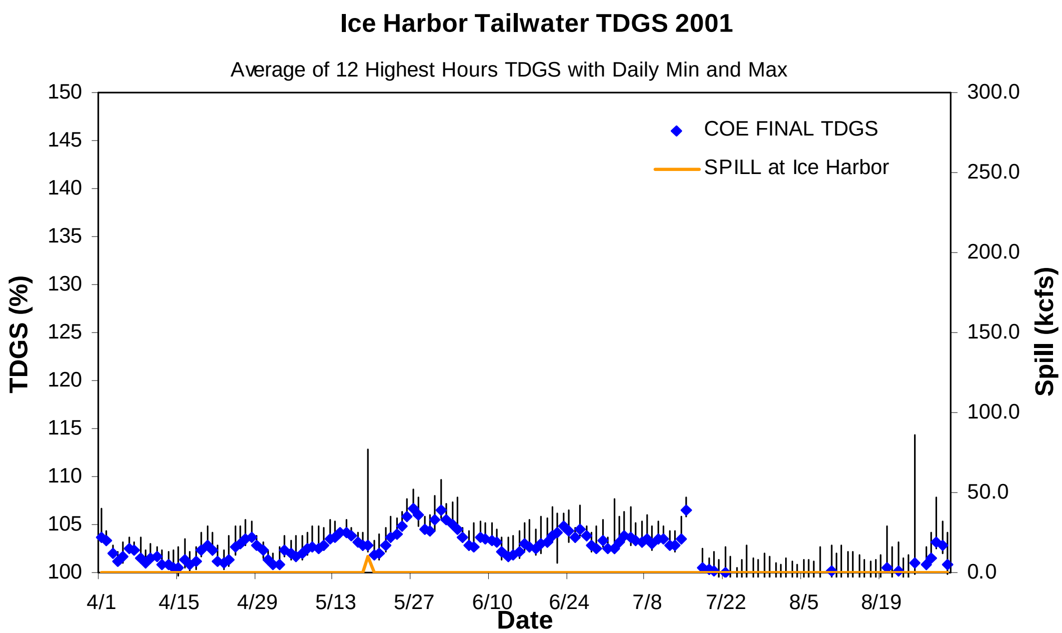


FIGURE B-8. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Tailwater

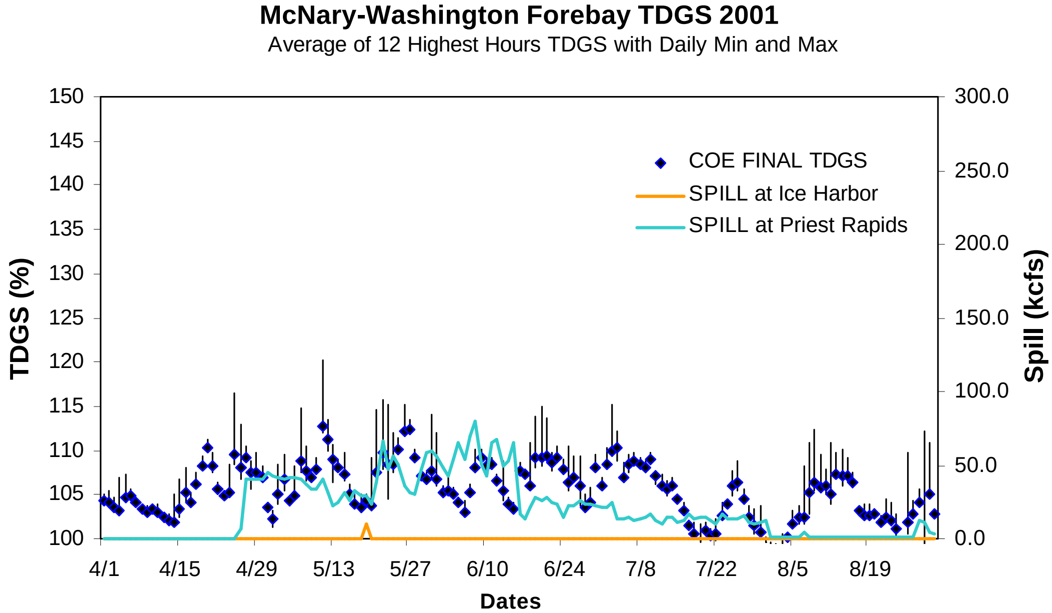


FIGURE B-9. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Washington Forebay.

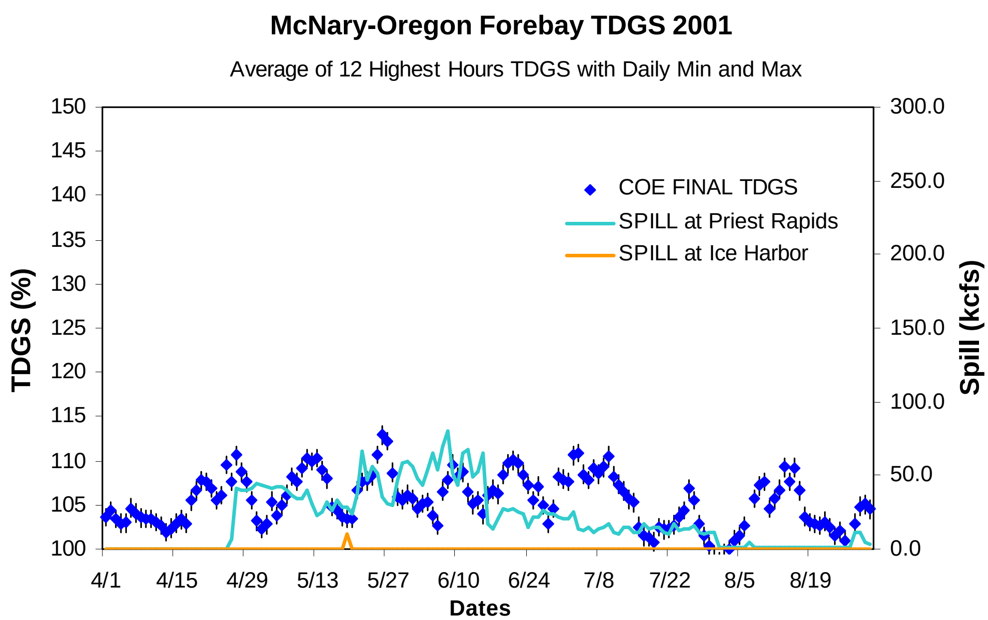


FIGURE B-10. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Oregon Forebay.

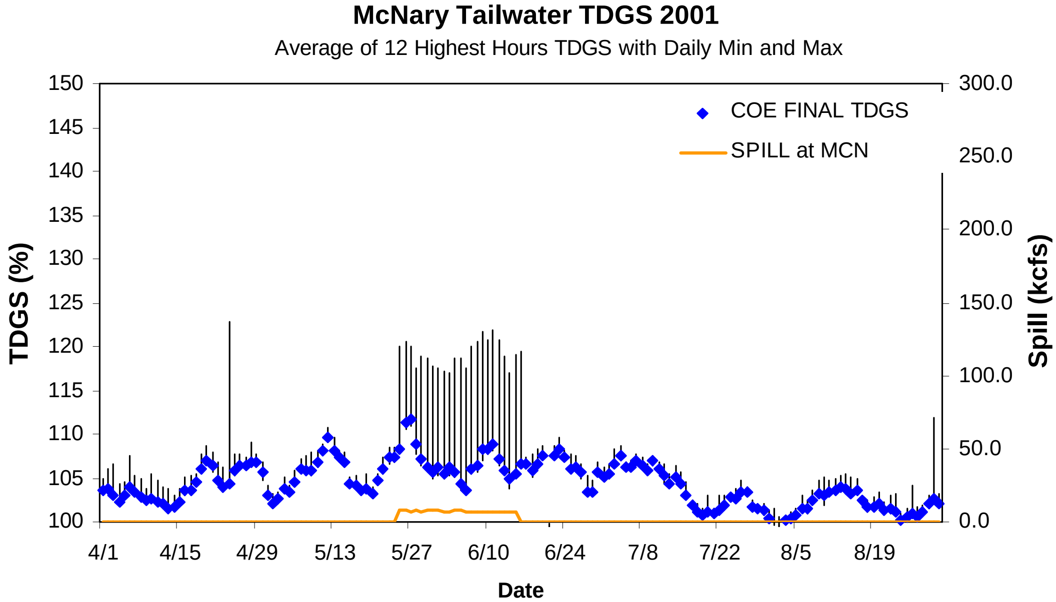


FIGURE B-11. Comparison of the daily average of the 12 highest hourly TDGS reading as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary Tailwater.

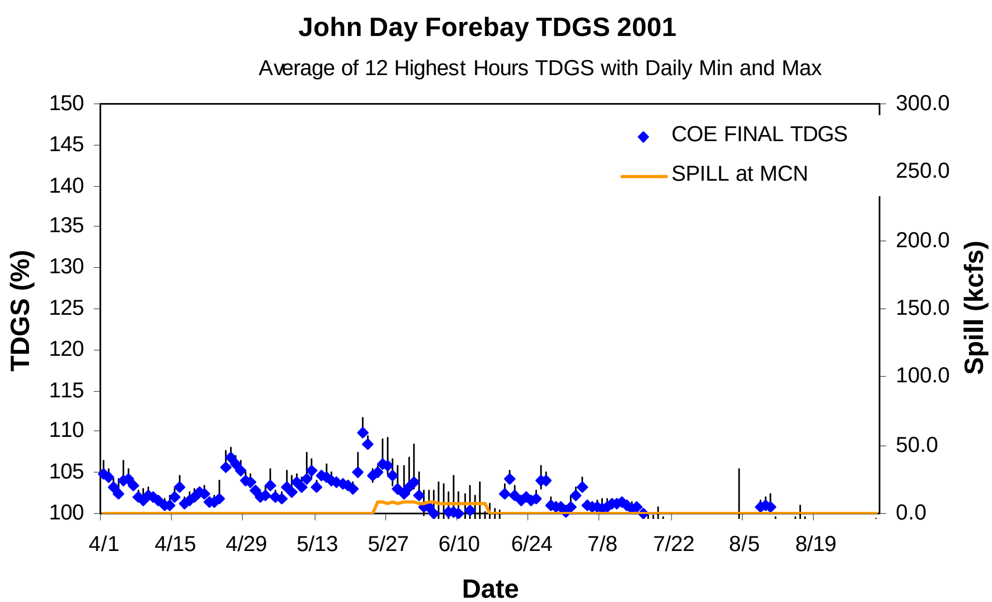


FIGURE B-12. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Forebay.

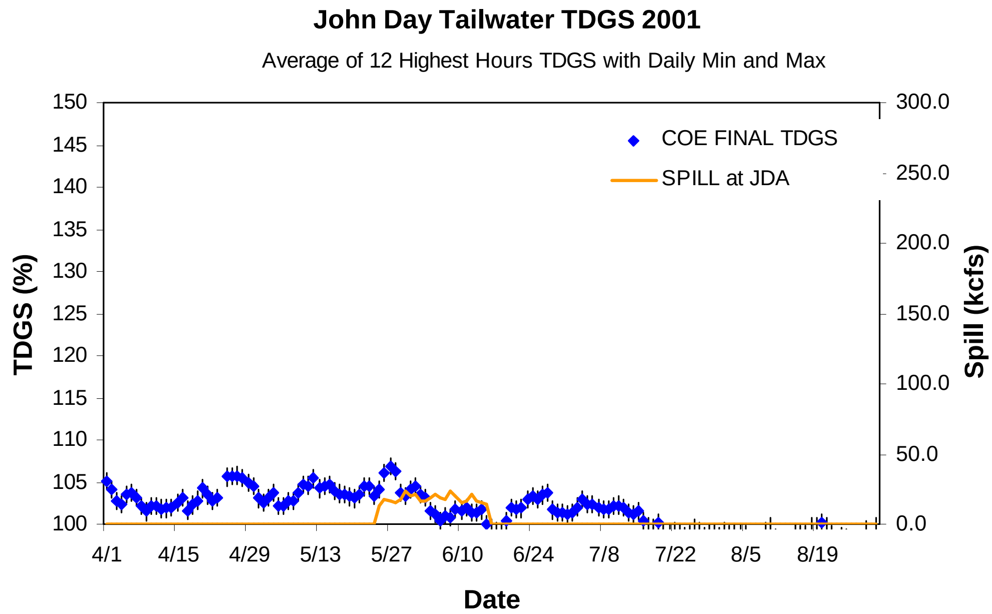


FIGURE B-13. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Tailwater.

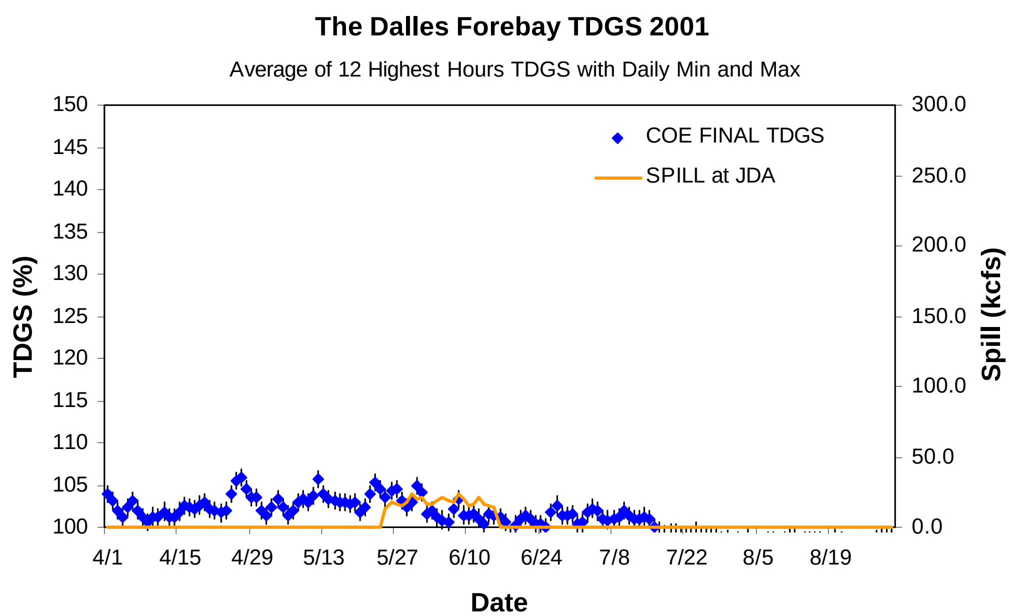


FIGURE B-14. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles Forebay.

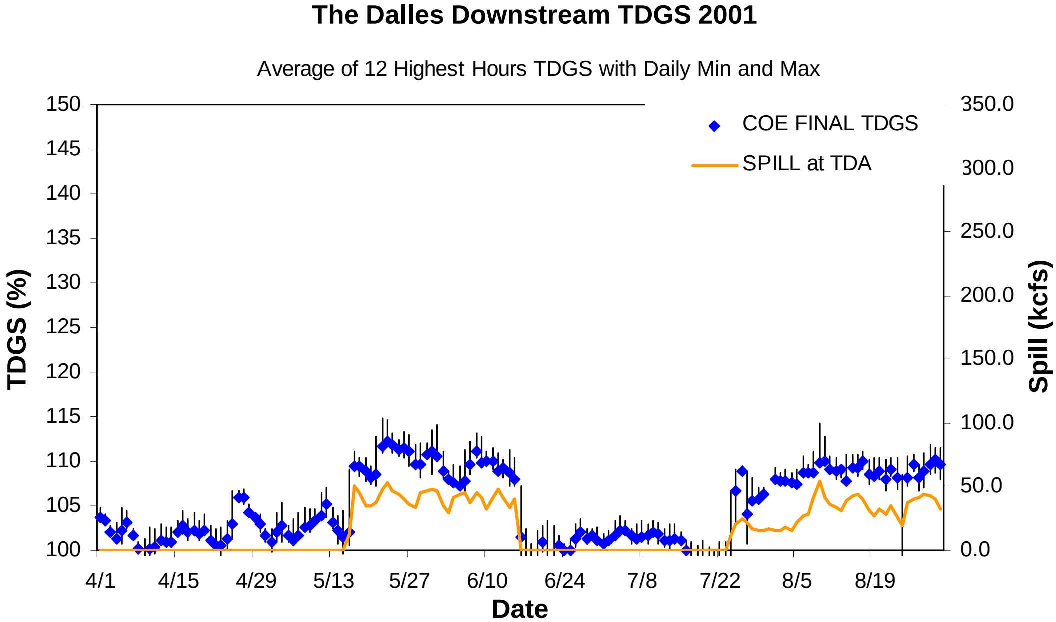


FIGURE B-15. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles (downstream).

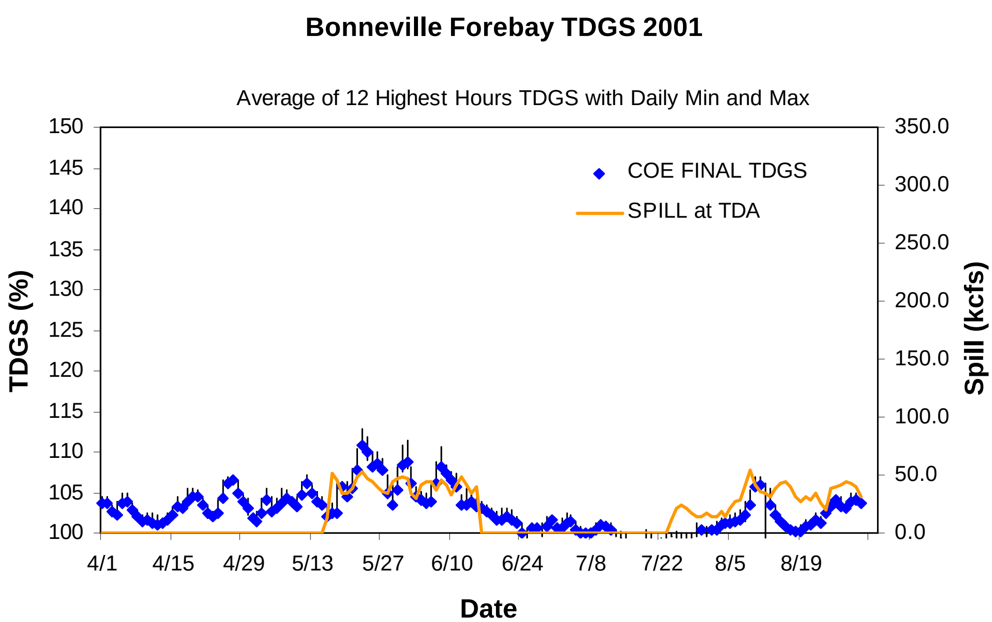


FIGURE B-16. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Bonneville Forebay.

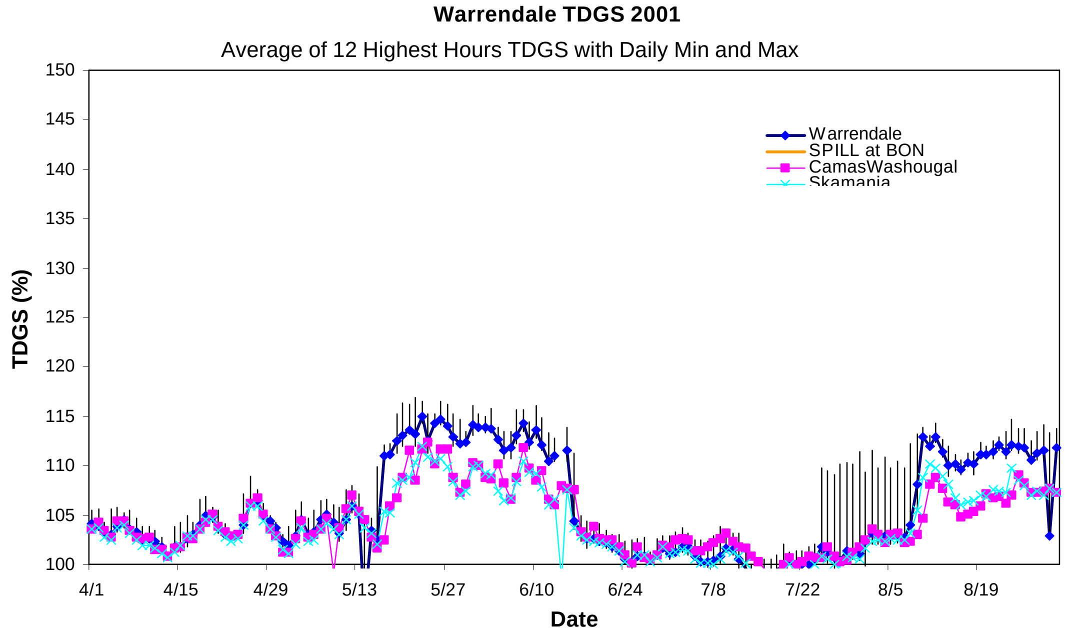


FIGURE B-17. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Warrendale.

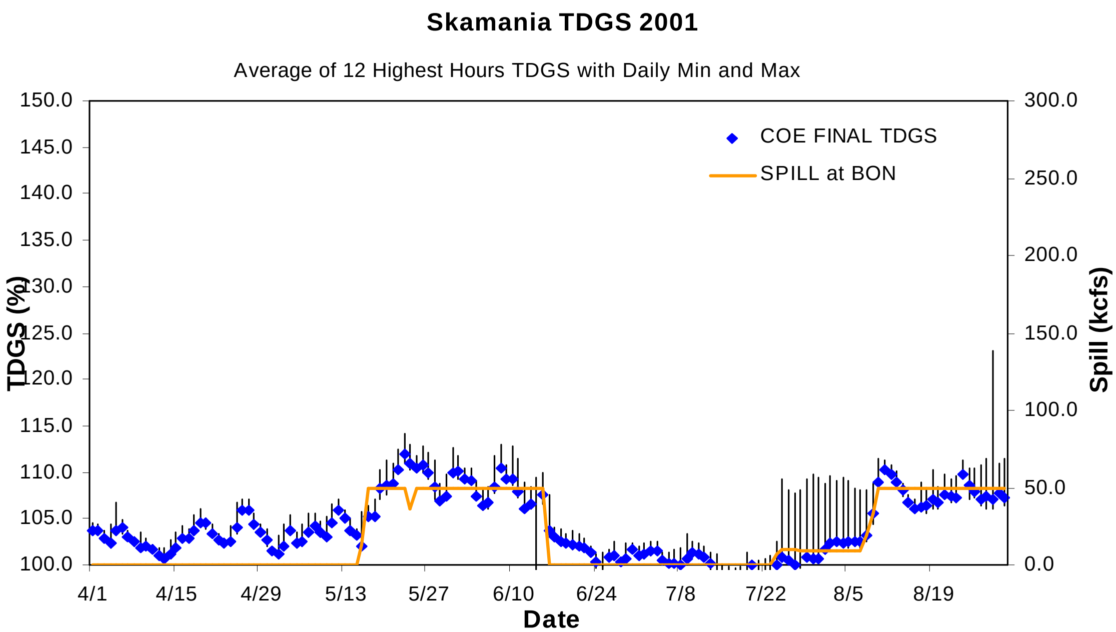


FIGURE B-18. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Skamania.

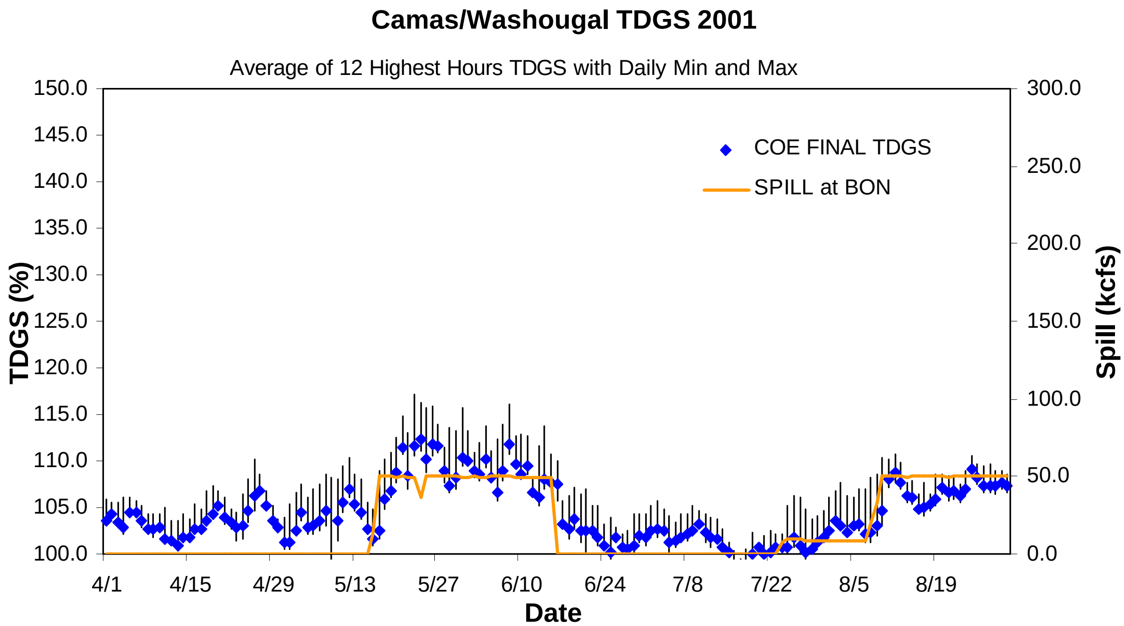


FIGURE B-19. Comparison of the daily average of the 12highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Camas/Washougal.

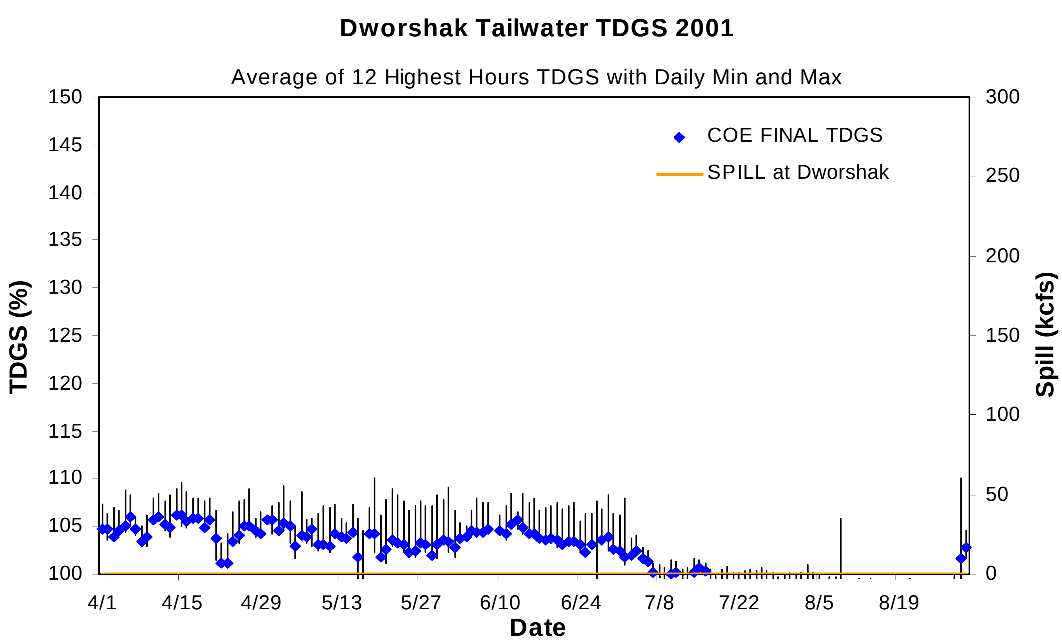


FIGURE B-20. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Dworshak Tailwater.

APPENDIX C

Gas Bubble Trauma and

Total Dissolved Gas Saturation

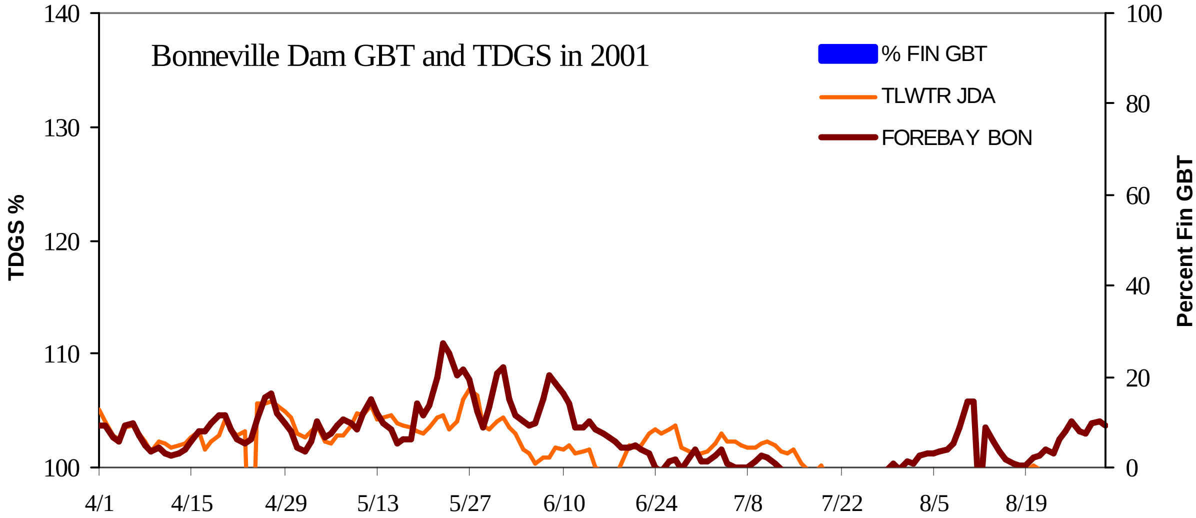


FIGURE C-1. Percent of fish examined at Bonneville Dam showing signs of GBT with associated dissolved gas saturation levels in the Bonneville Dam forebay and the John Day Dam tailwater.

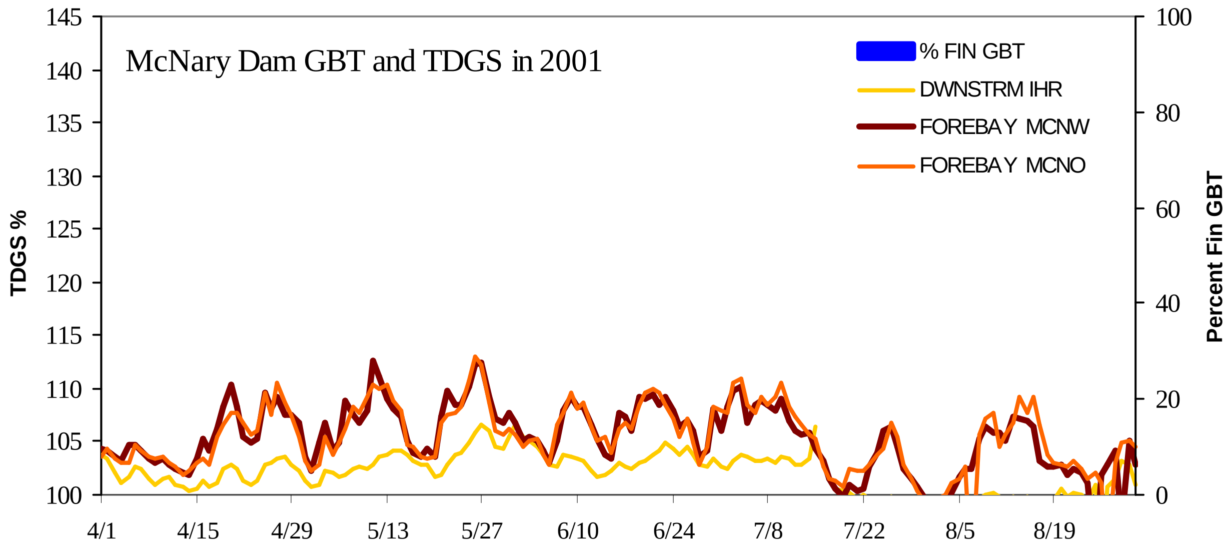


FIGURE C-2. Percent of fish examined at McNary Dam showing signs of GBT with associated dissolved gas saturation levels in the McNary Dam forebay (Oregon and Washington sides) and the Ice Harbor Dam tailwater

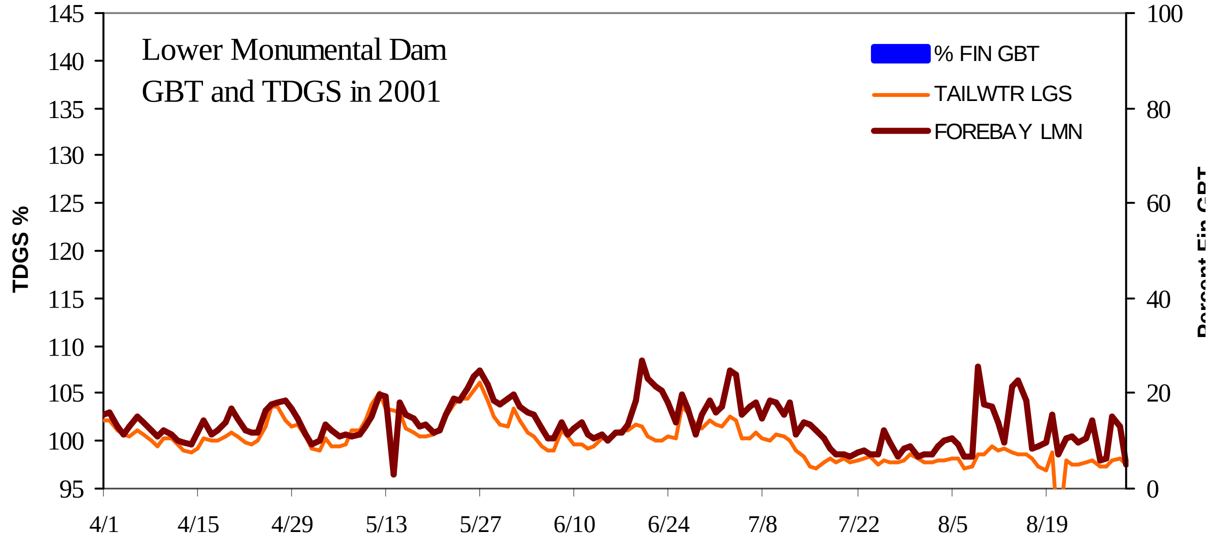


FIGURE C-3. Percent of fish examined at Lower Monumental Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Monumental Dam forebay and the Little Goose Dam tailwater.

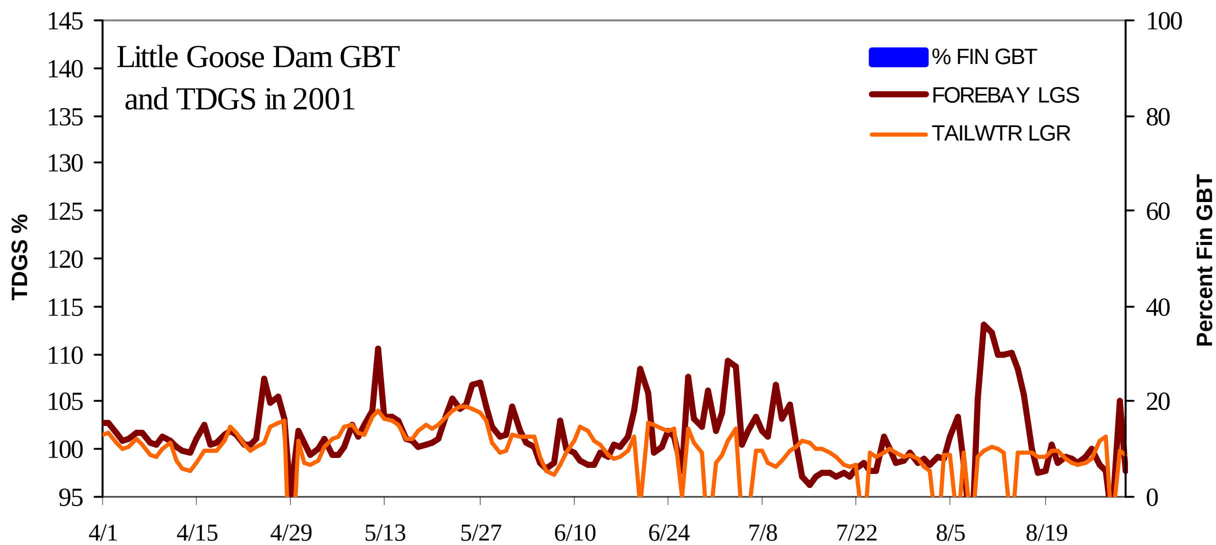


FIGURE C-4. Percent of fish examined at Little Goose Dam showing signs of GBT with associated dissolved gas saturation levels in the Little Goose Dam forebay and the Lower Granite Dam tailwater.

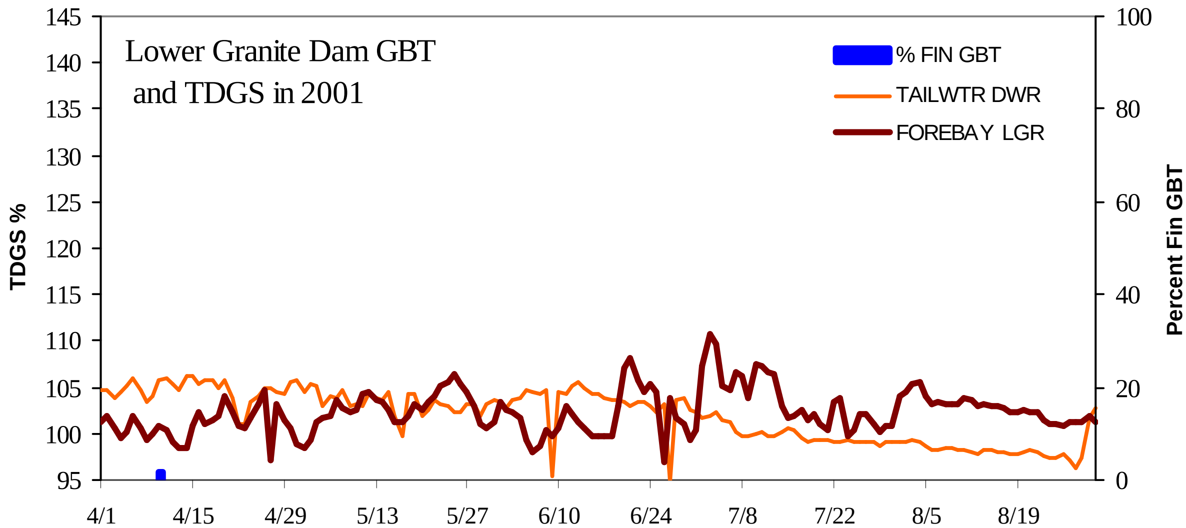


FIGURE C-5. Percent of fish examined at Lower Granite Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Granite Dam forebay and the Dworshak Dam tailwater.

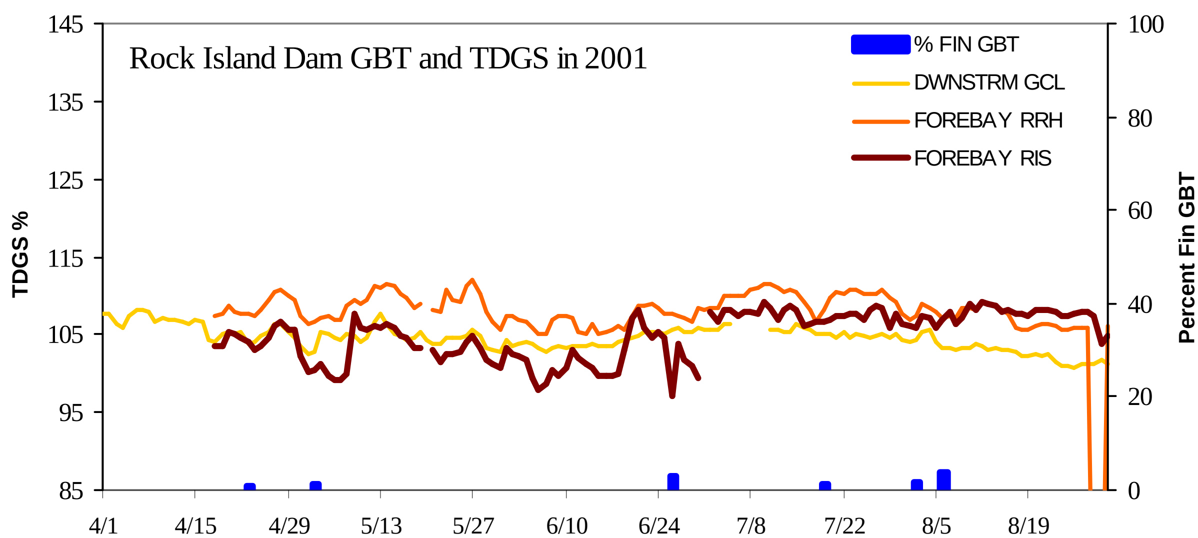


FIGURE C-6. Percent of fish examined at Rock Island Dam showing signs of GBT with associated dissolved gas saturation levels in the Rock Island and Rocky Reach Dam forebays and the Grand Coulee Dam tailwater.

APPENDIX D

Migration Timing Plots

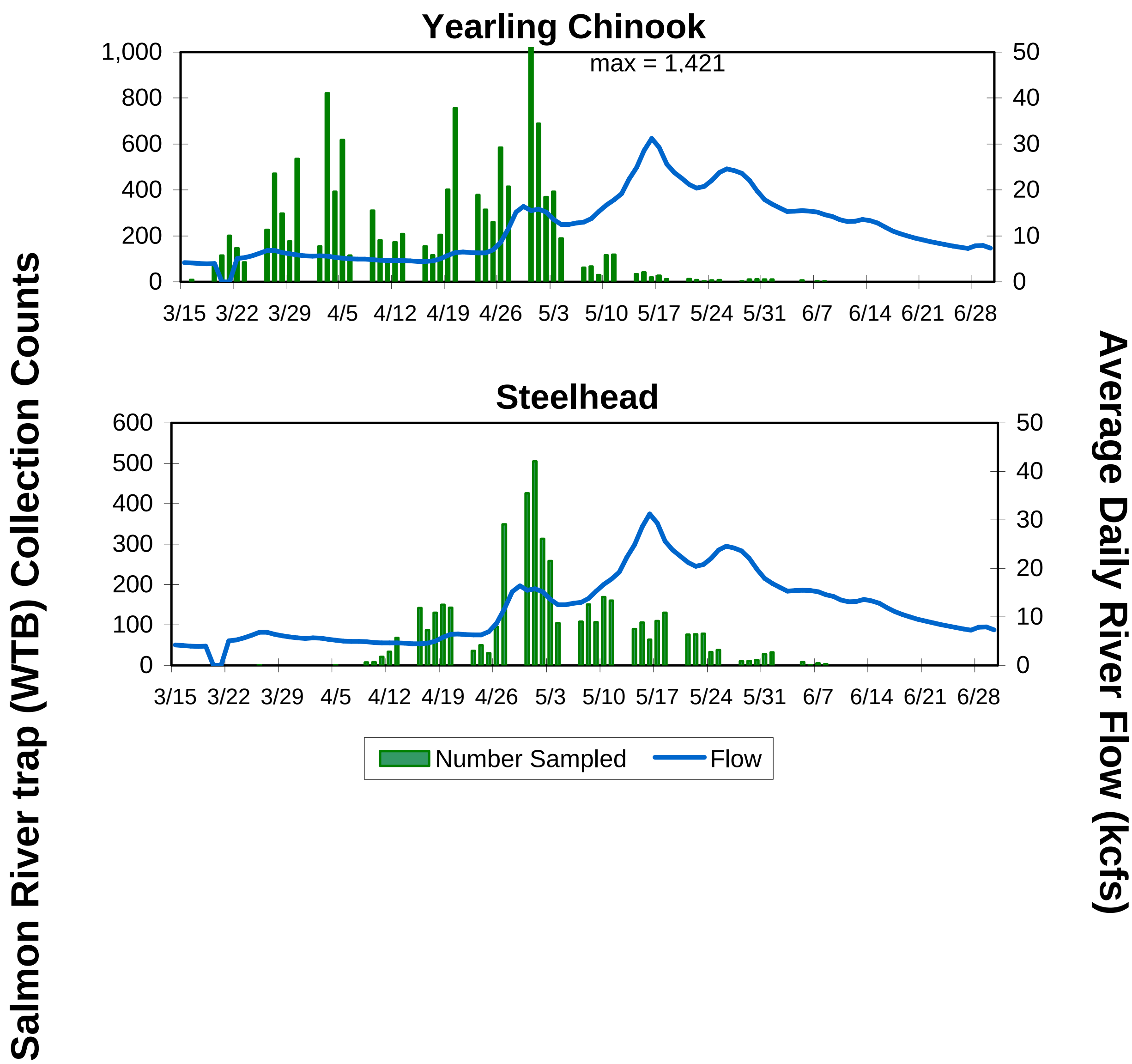


FIGURE D-1. Smolt migration timing at Salmon River Trap (WTB) with associated flow, 2001.

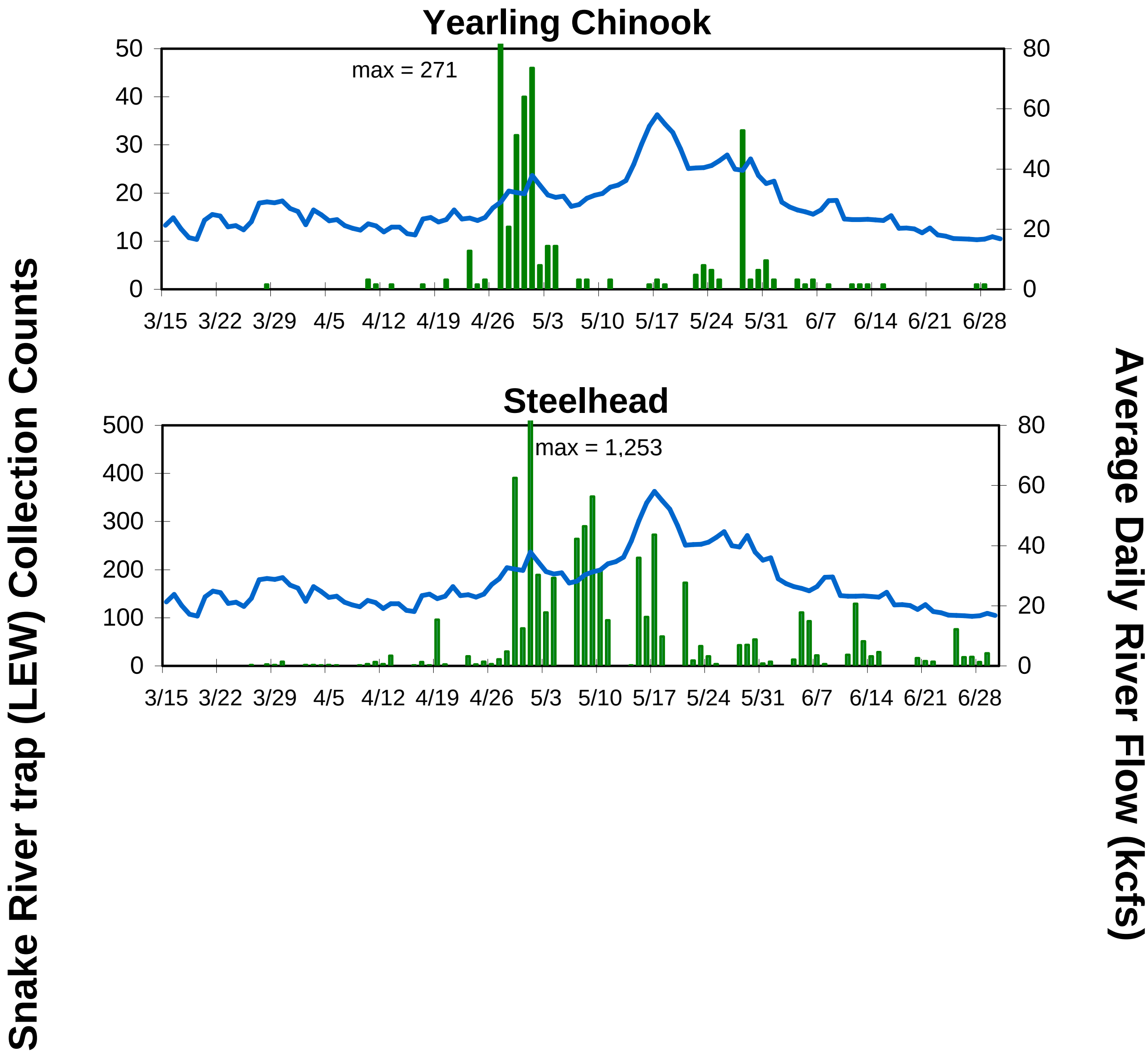


FIGURE D-2. Smolt migration timing at Snake River trap (LEW) and associated flow, 2001.

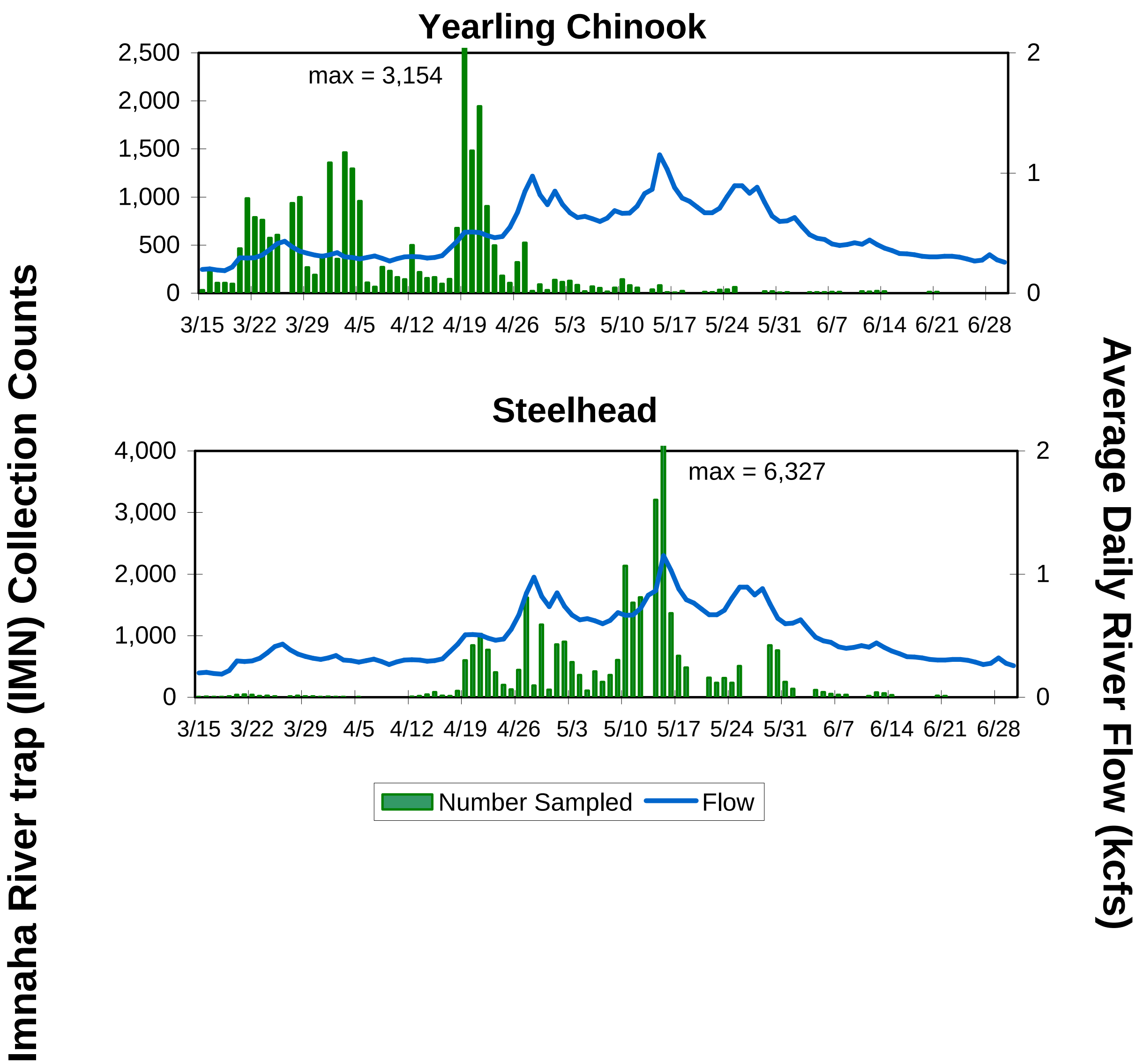


FIGURE D-3. Smolt migration timing at Imnaha River trap with associated flows, 2001.

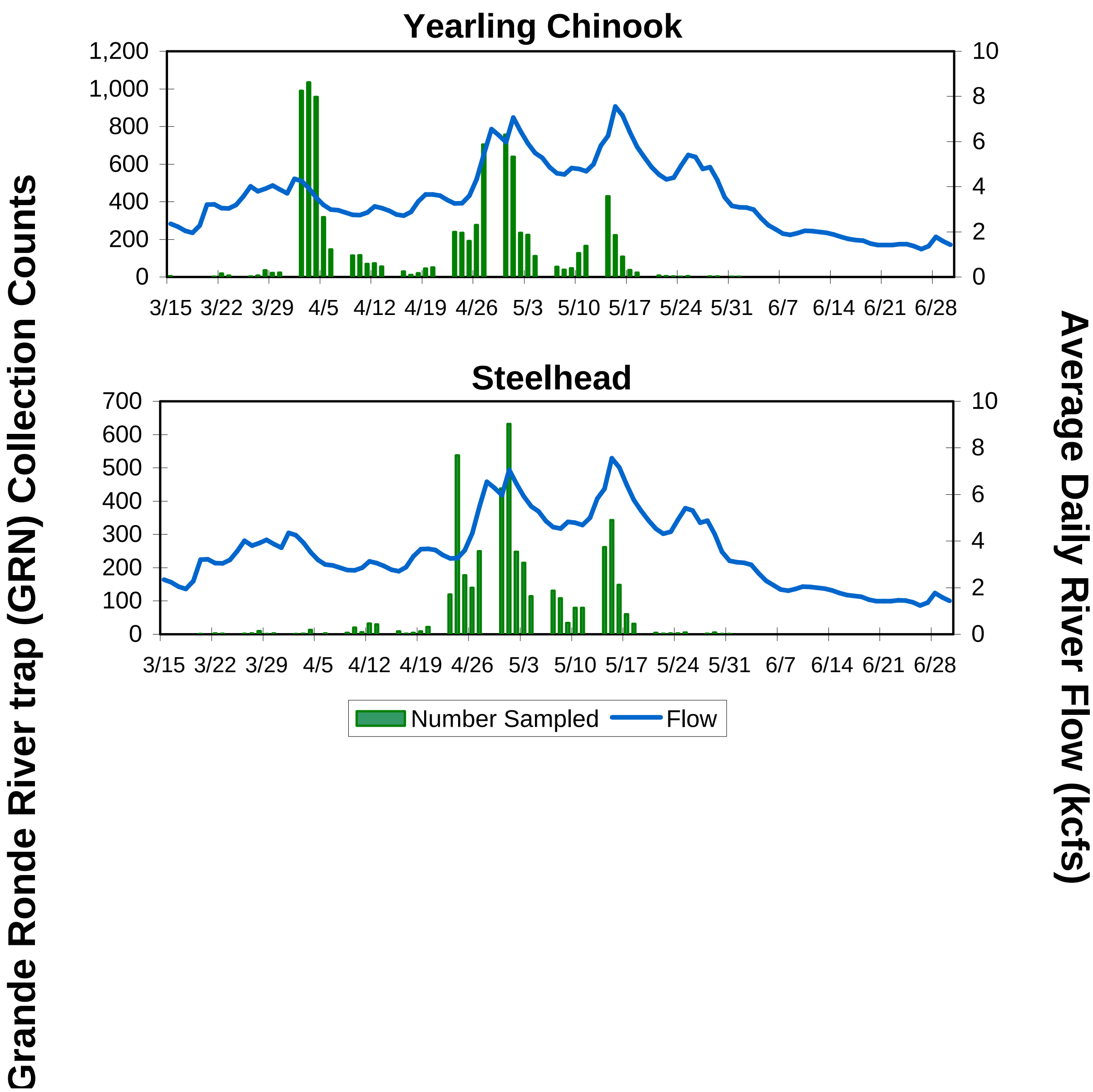


FIGURE D-4. Smolt migration timing at Grande Ronde River Trap with associated flows, 2001.

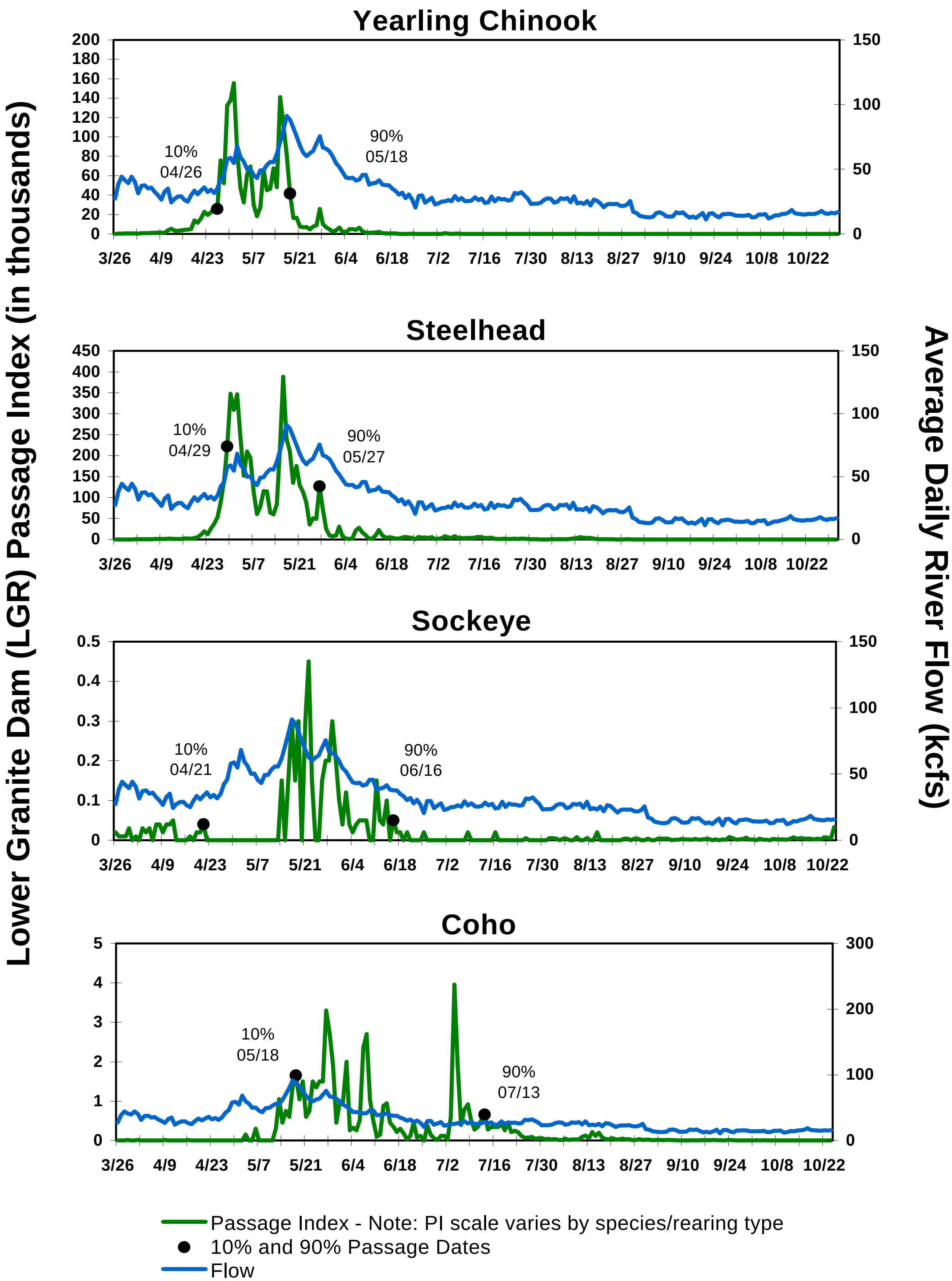


FIGURE D-5. Smolt migration timing at Lower Granite Dam with associated flow, 2001.

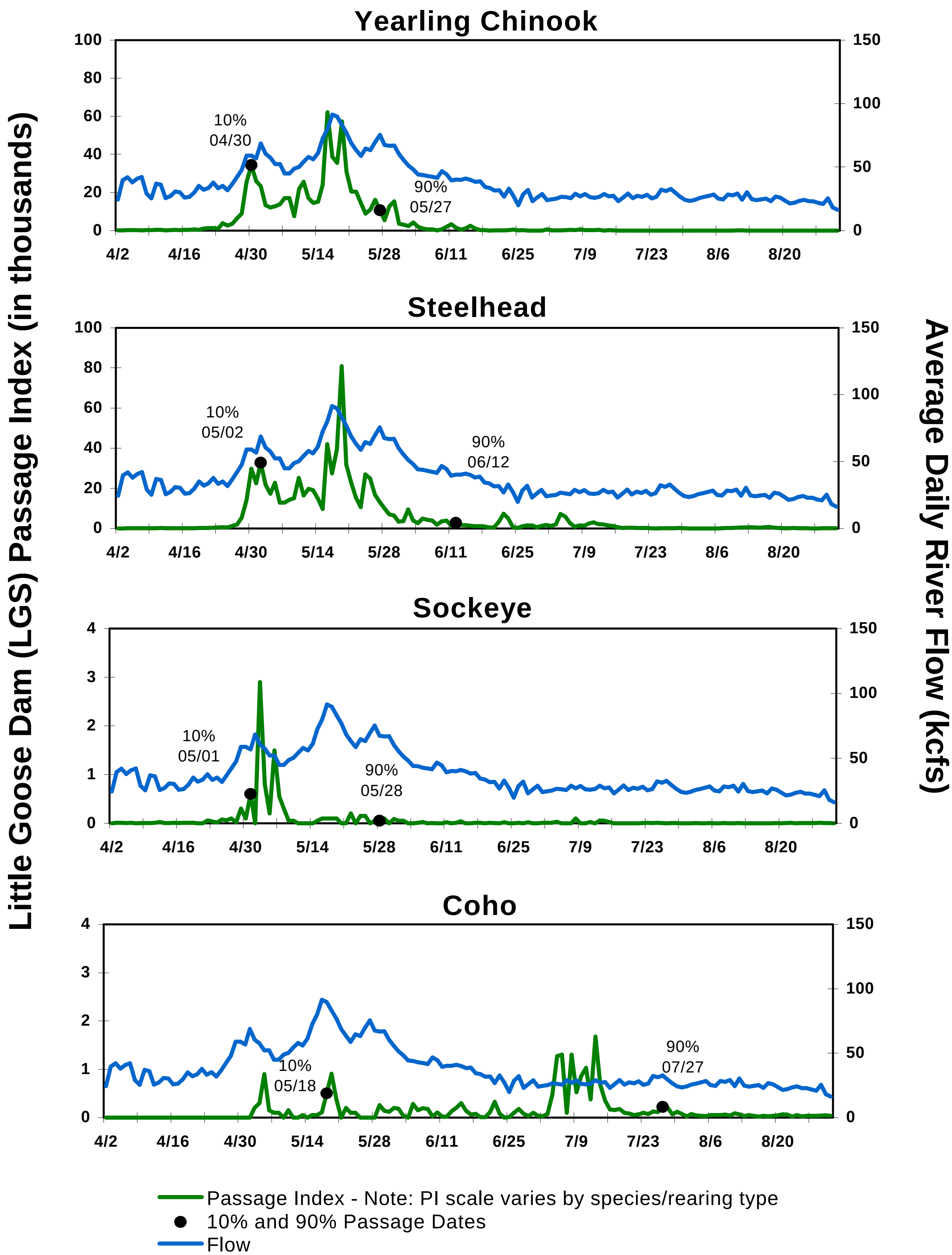


FIGURE D-6. Smolt migration timing at Little Goose Dam with associated flows, 2001.

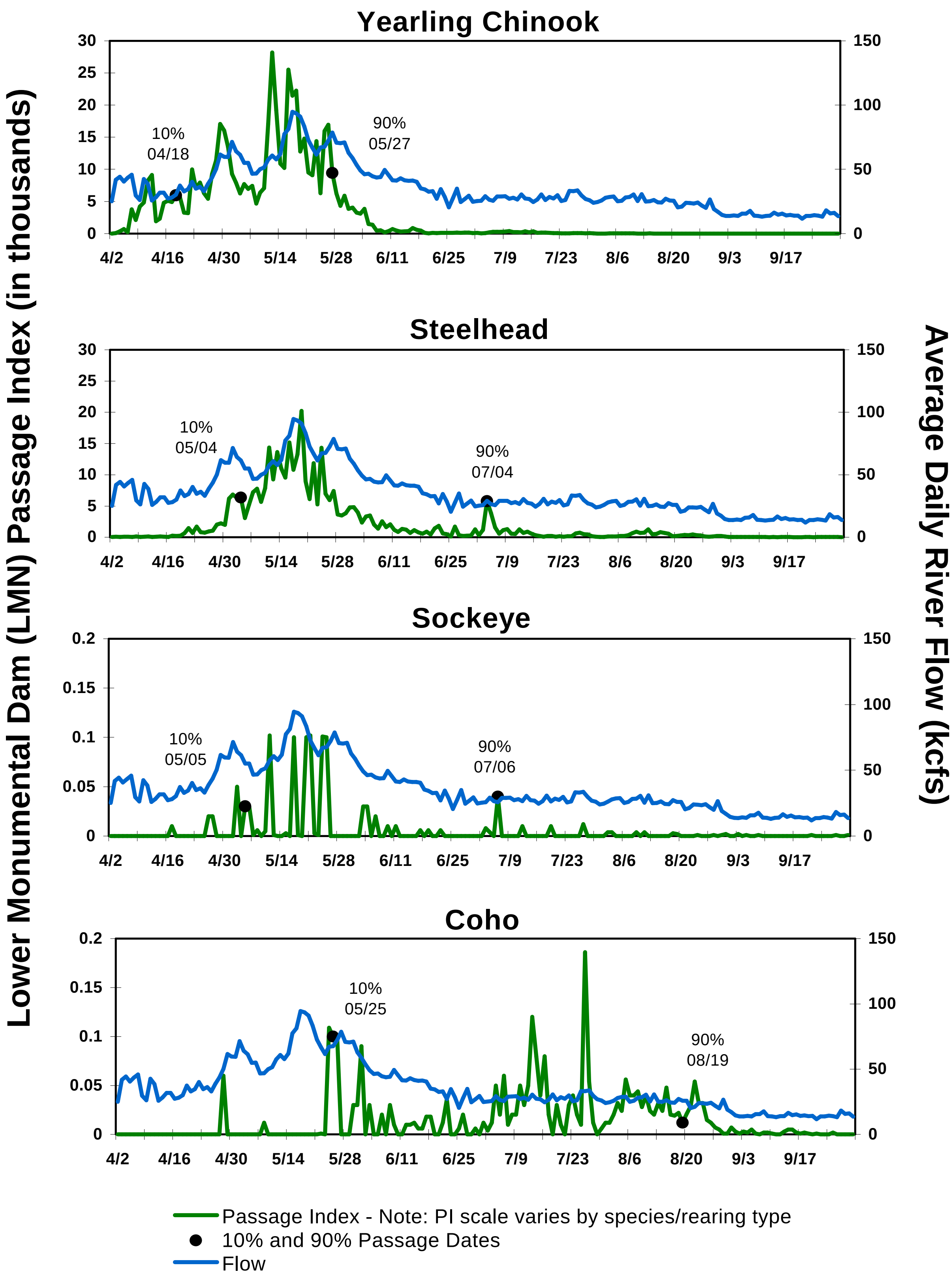


FIGURE D-7. Smolt Migration timing at Lower Monumental Dam with associated flow, 2001.

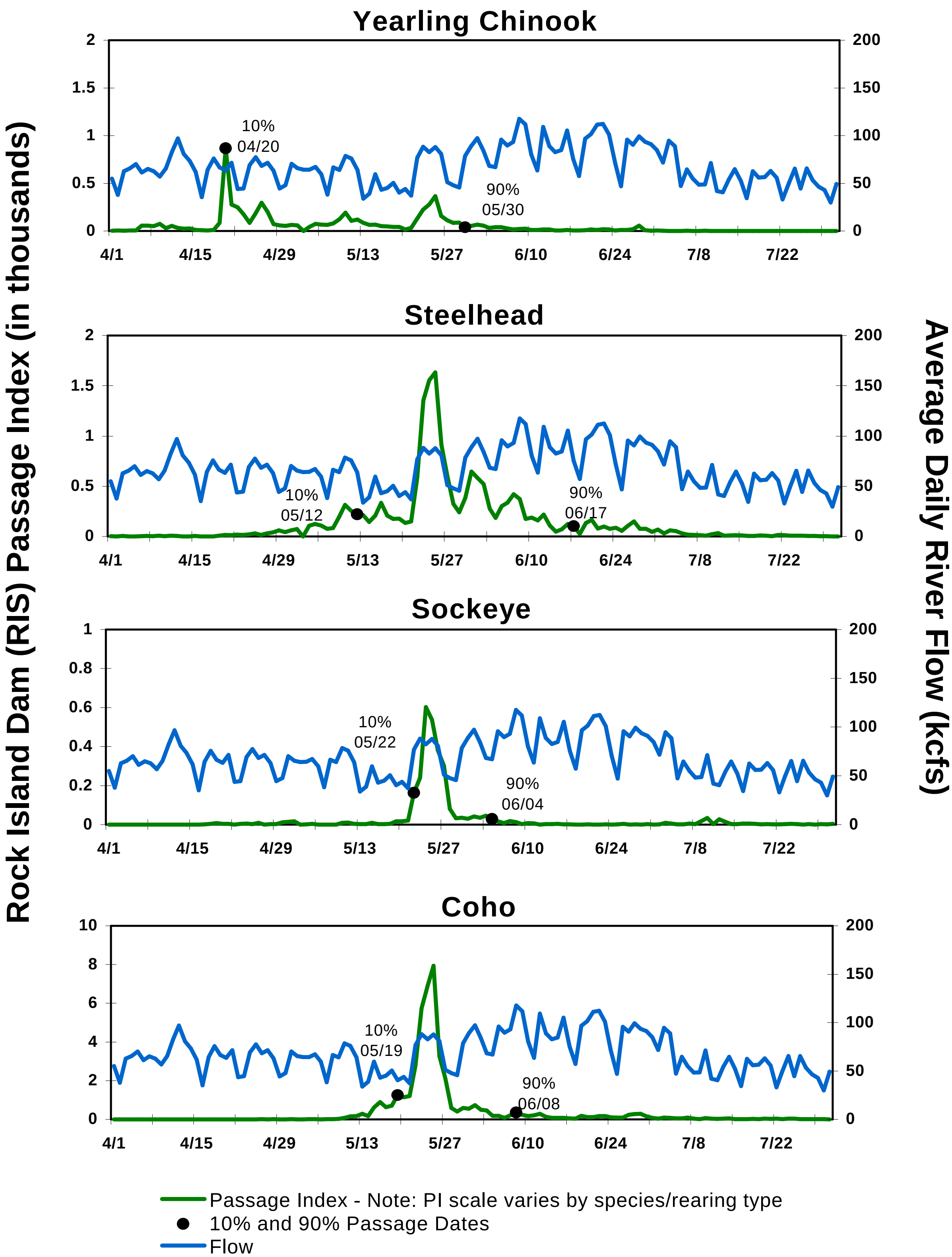


FIGURE D-8. Smolt migration timing at Rock Island Dam with associated flow, 2001.

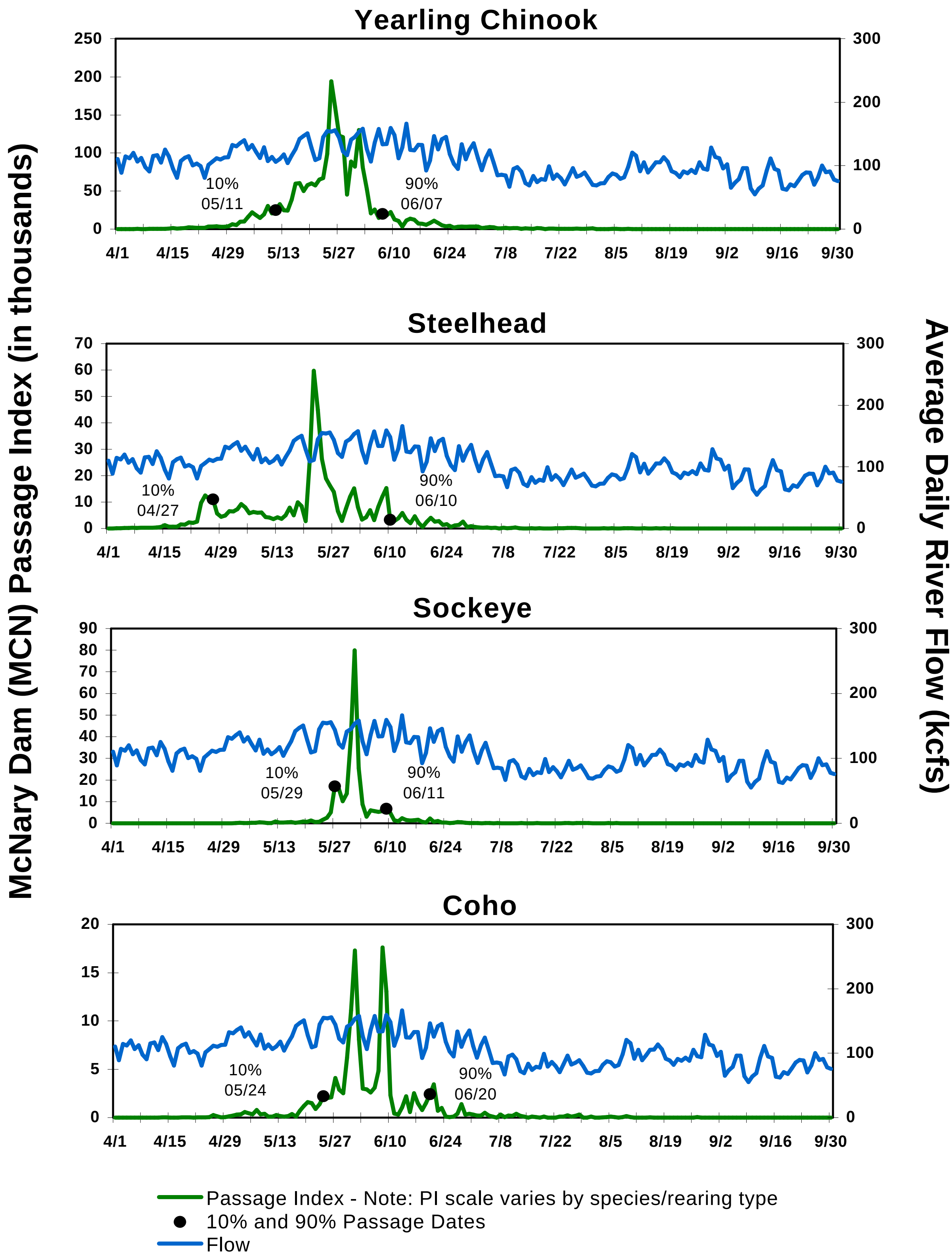


FIGURE D-9. Smolt migration timing at McNary Dam with associated flow, 2001.

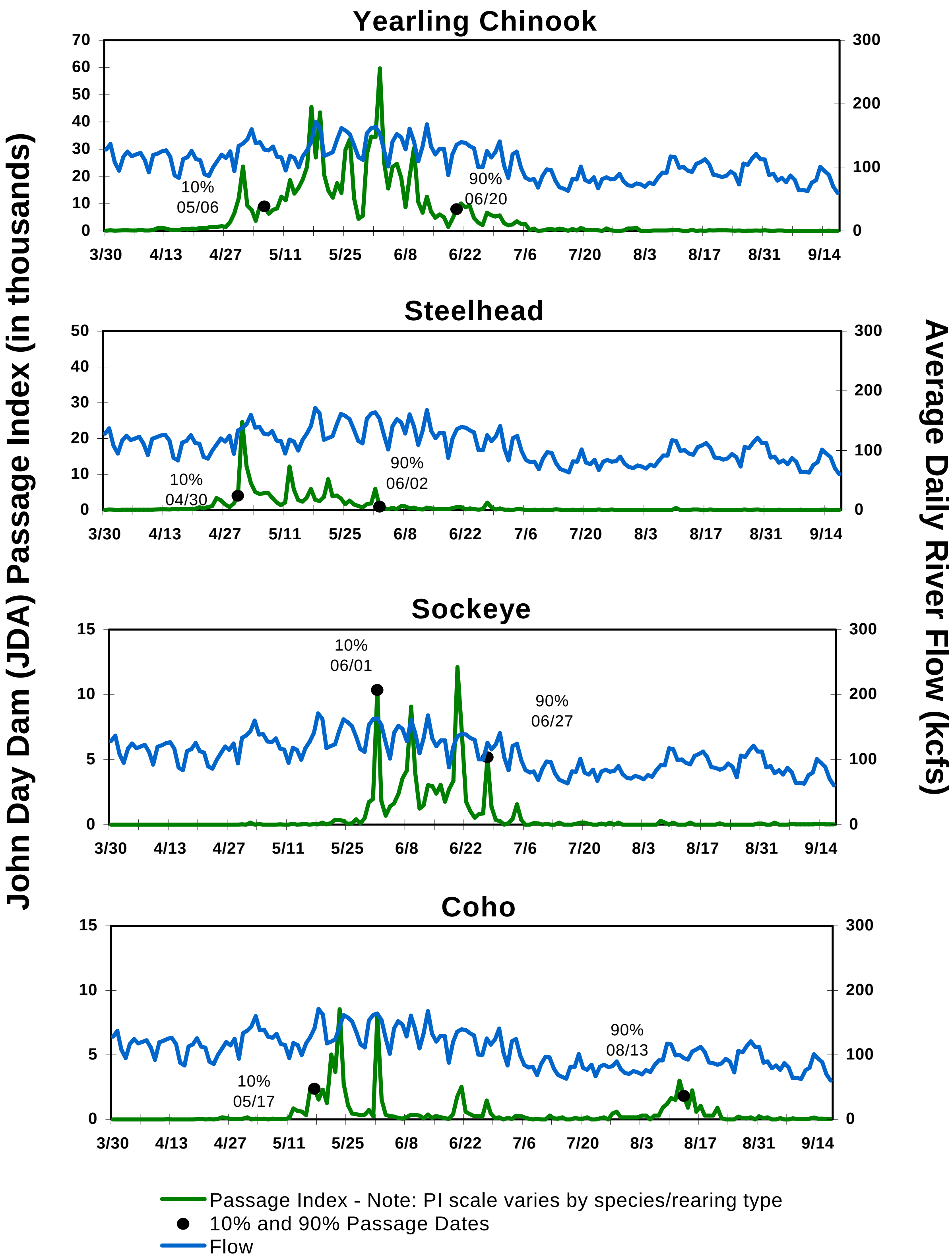


FIGURE D-10. Smolt migration timing at John Day Dam with associated flow, 2001.

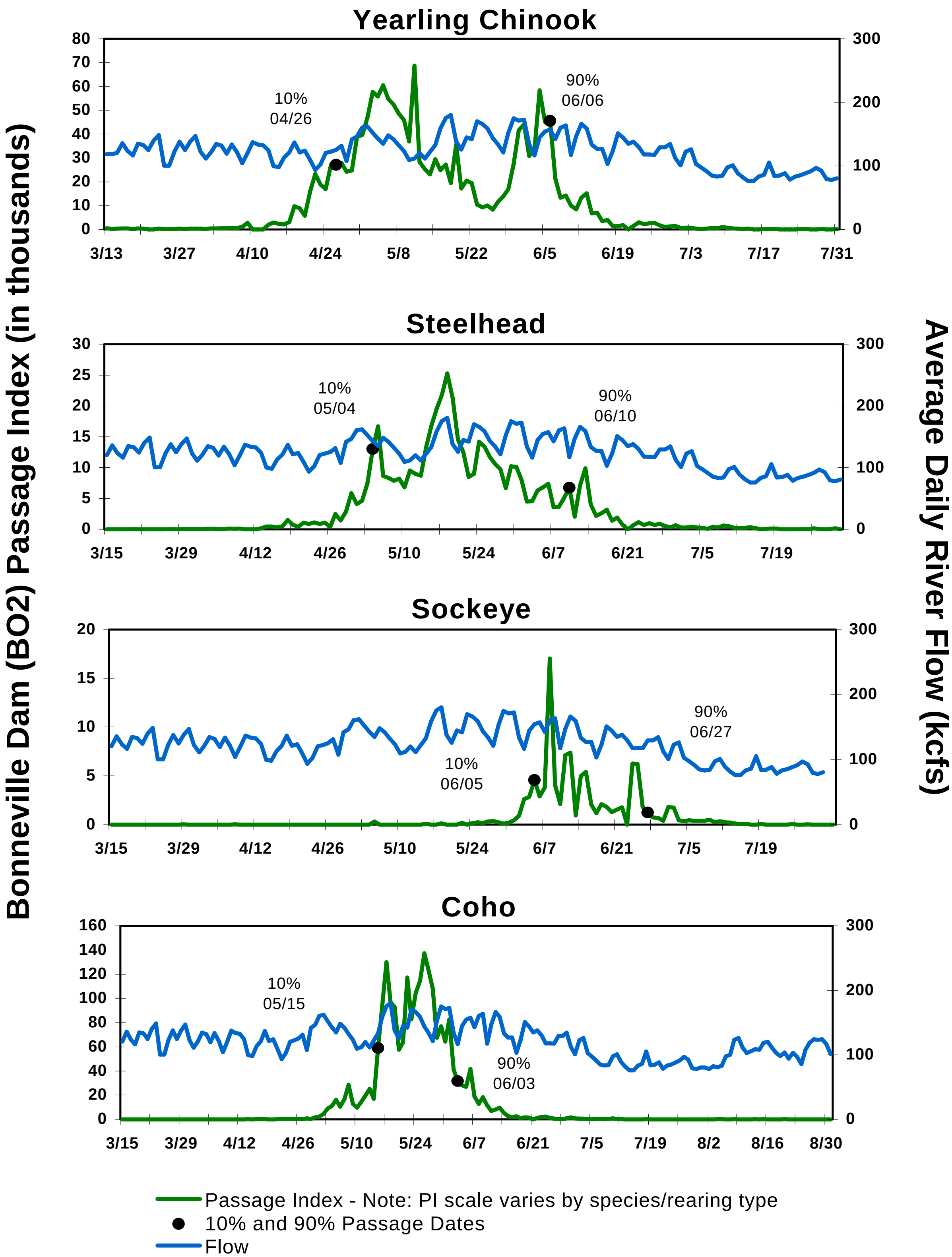


FIGURE D-11. Smolt migration timing at Bonneville Powerhouse II (BO2) with associated flow, 2001.

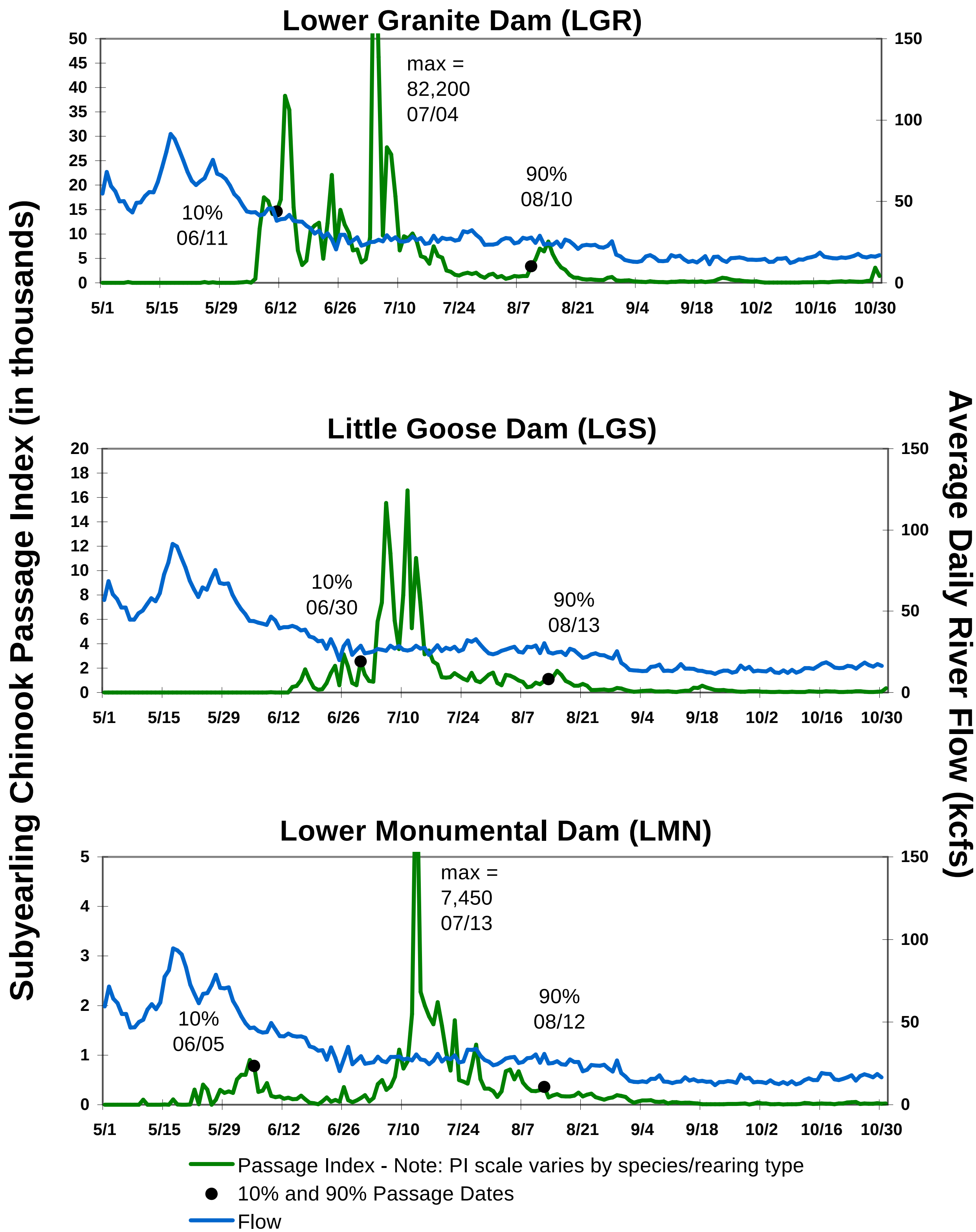


FIGURE D-12. Subyearling chinook smolt migration timing at Snake River sites with associated flow, 2001.

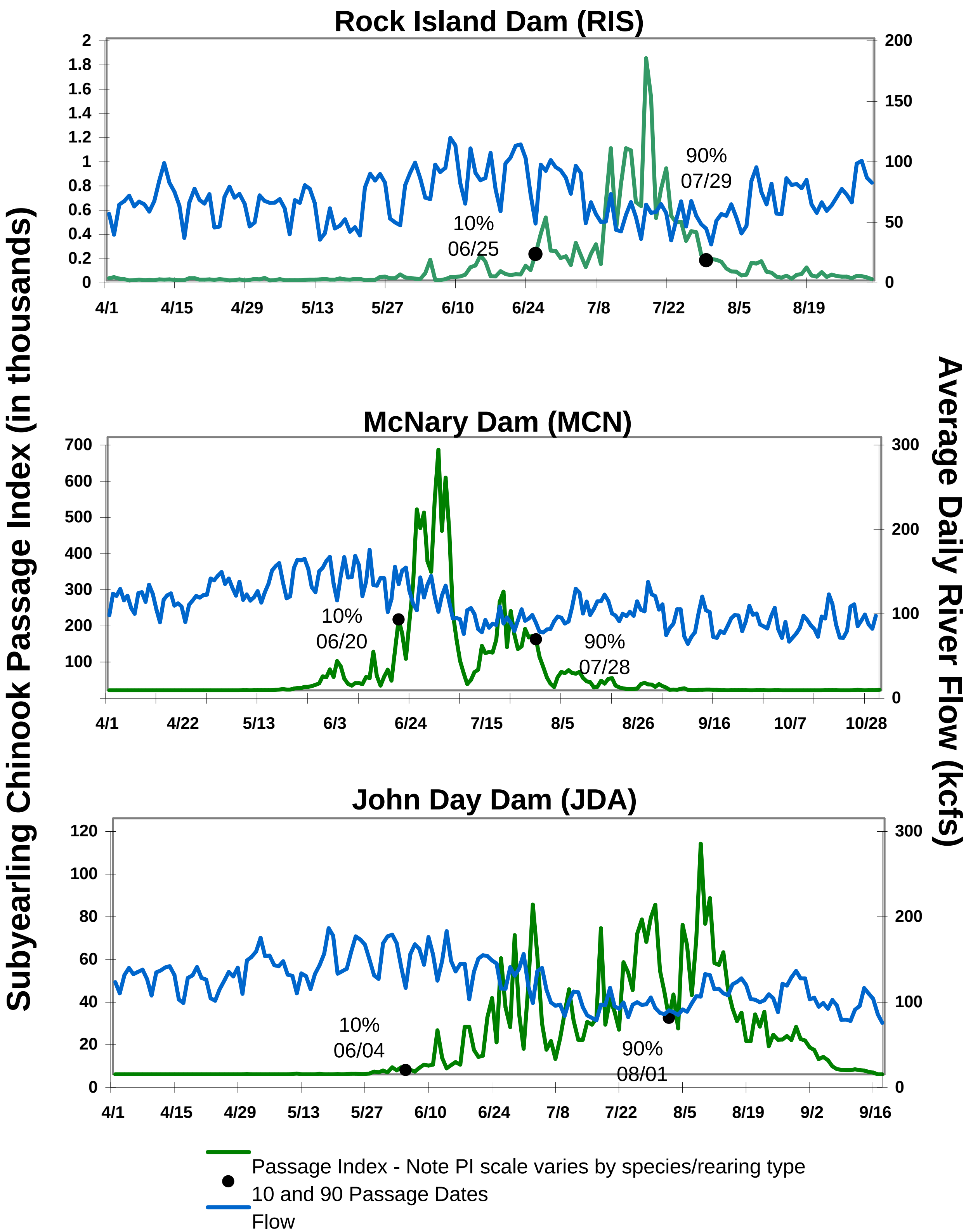
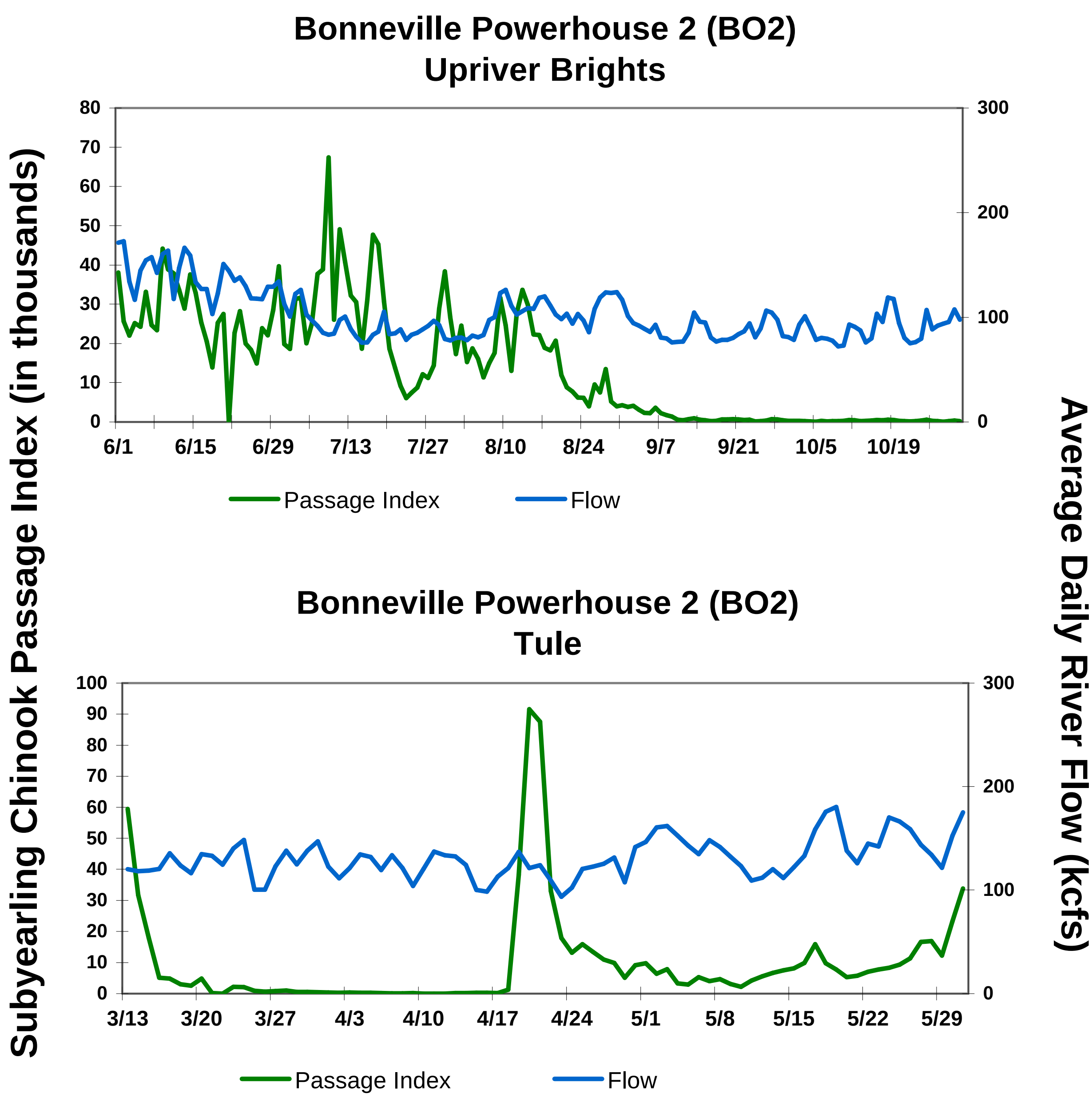


FIGURE D-13. Subyearling chinook smolt migration timin at Snake River sites with associated flow, 2001.



Spring Creek Hatchery Chinook (Tule) released on:

Date	Number Released
03/08/01	5,314,481
04/16/01	5,255,329

FIGURE D-14. Subyearling chinook smolt migration timing at Columbia River sites with associated flow, 2001.

APPENDIX E

PIT Tagged Smolts Timing at John Day Dam

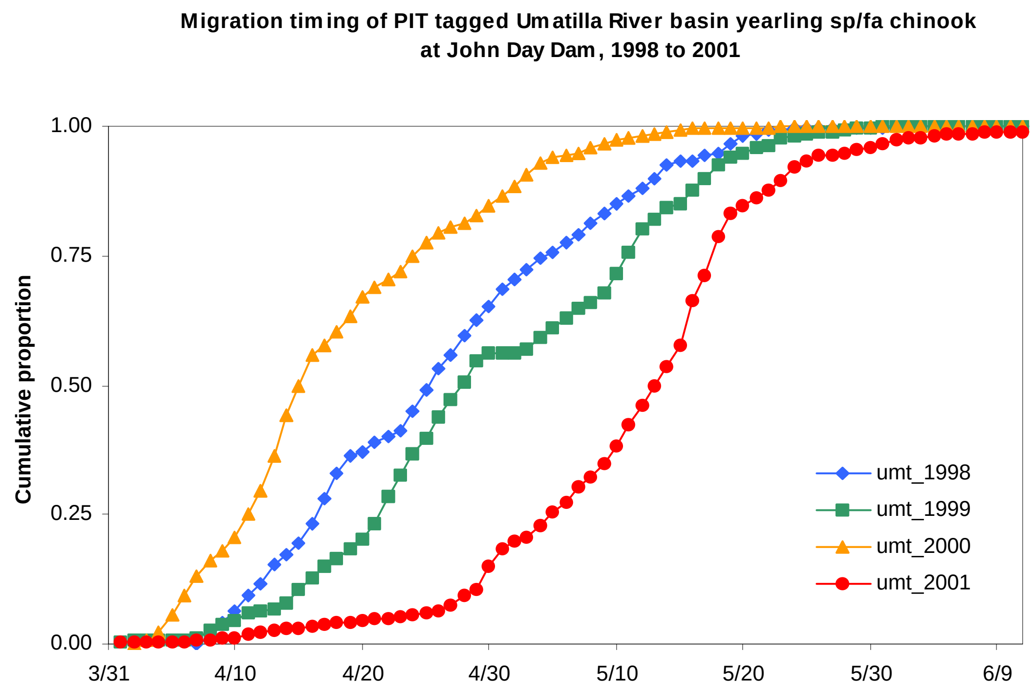


FIGURE E-1. UMATILLA RIVER YEARLING CHINOOK AT JOHN DAY DAM.

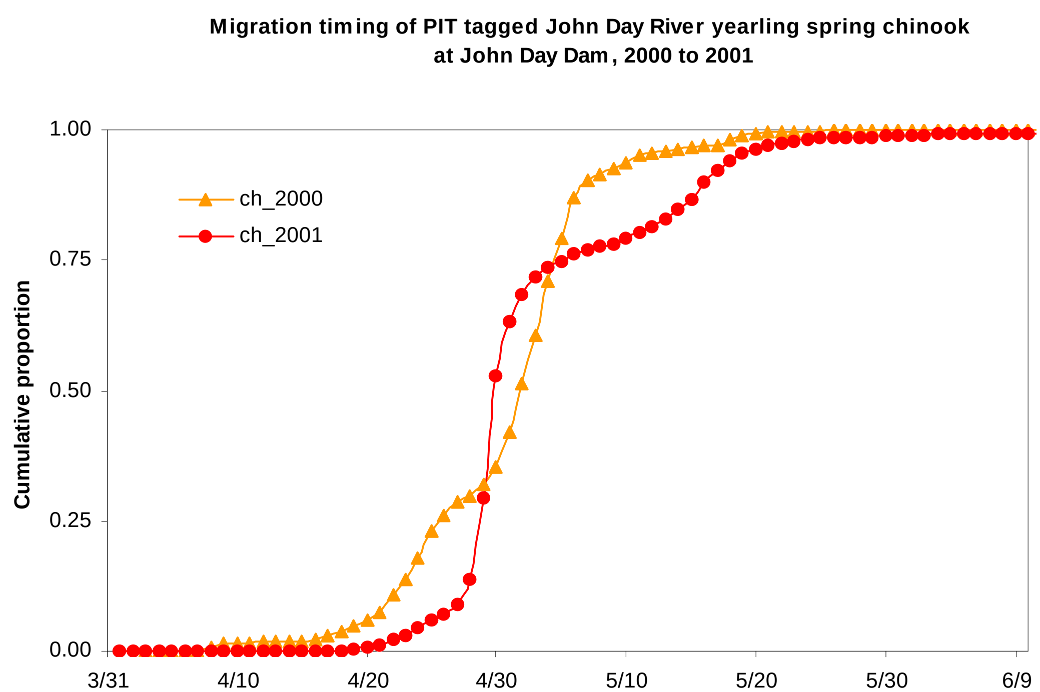


FIGURE E-2. JOHN DAY RIVER YEARLING CHINOOK AT JOHN DAY DAM.

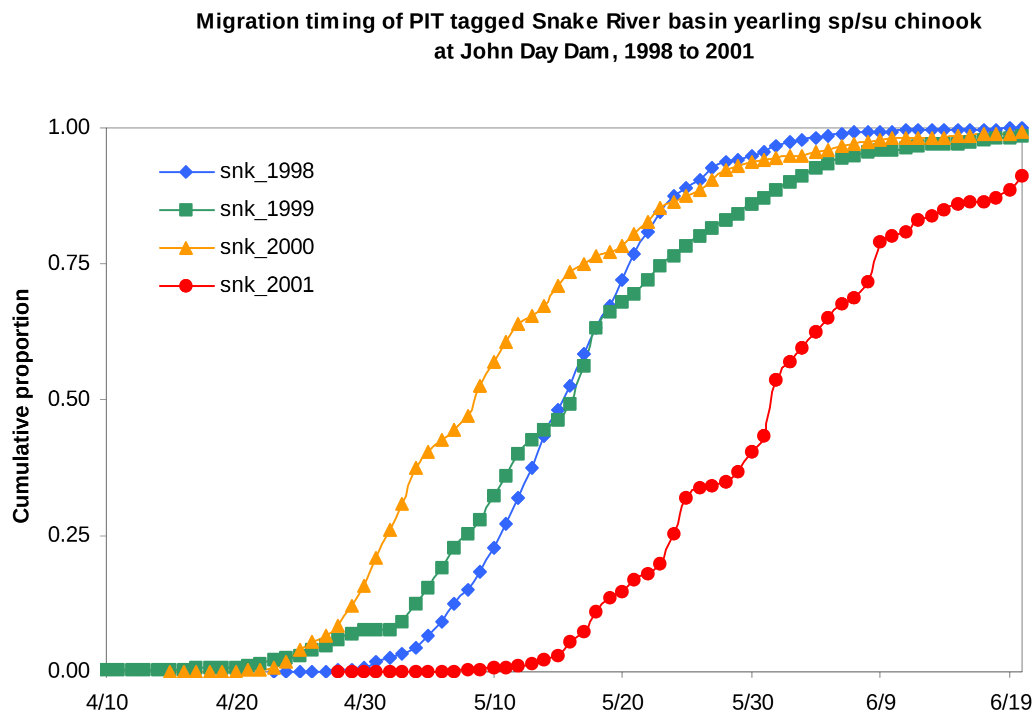


FIGURE E-3. SNAKE RIVER BASIN YEARLING CHINOOK AT JOHN DAY DAM.

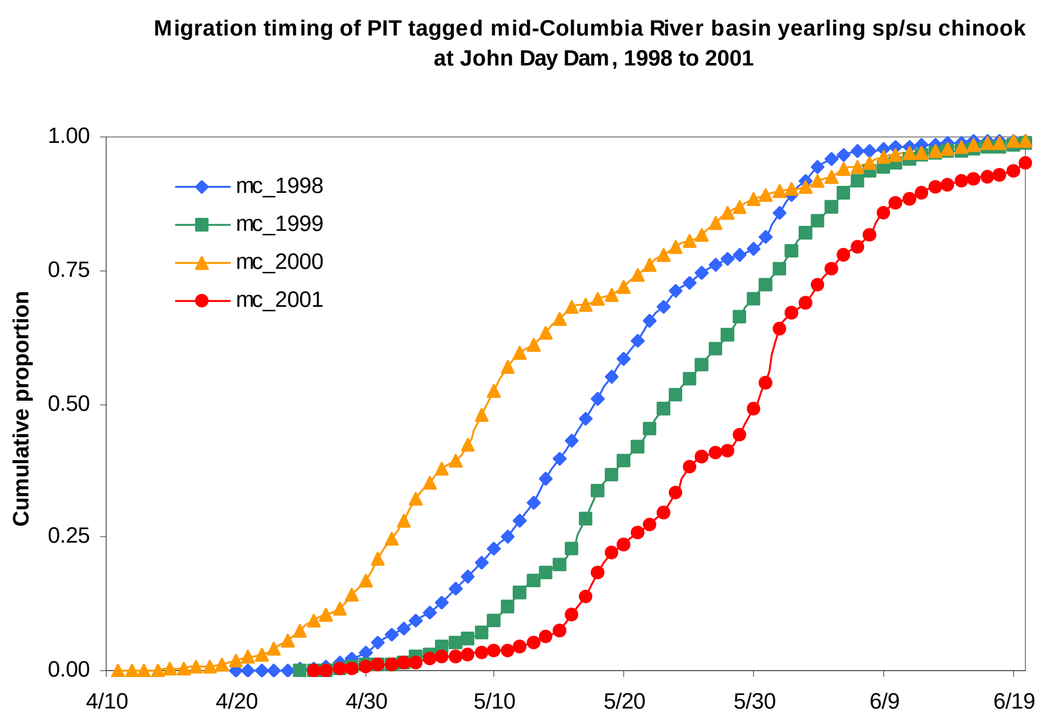


FIGURE E-4. MID-COLUMBIA BASIN YEARLING CHINOOK AT JOHN DAY DAM.

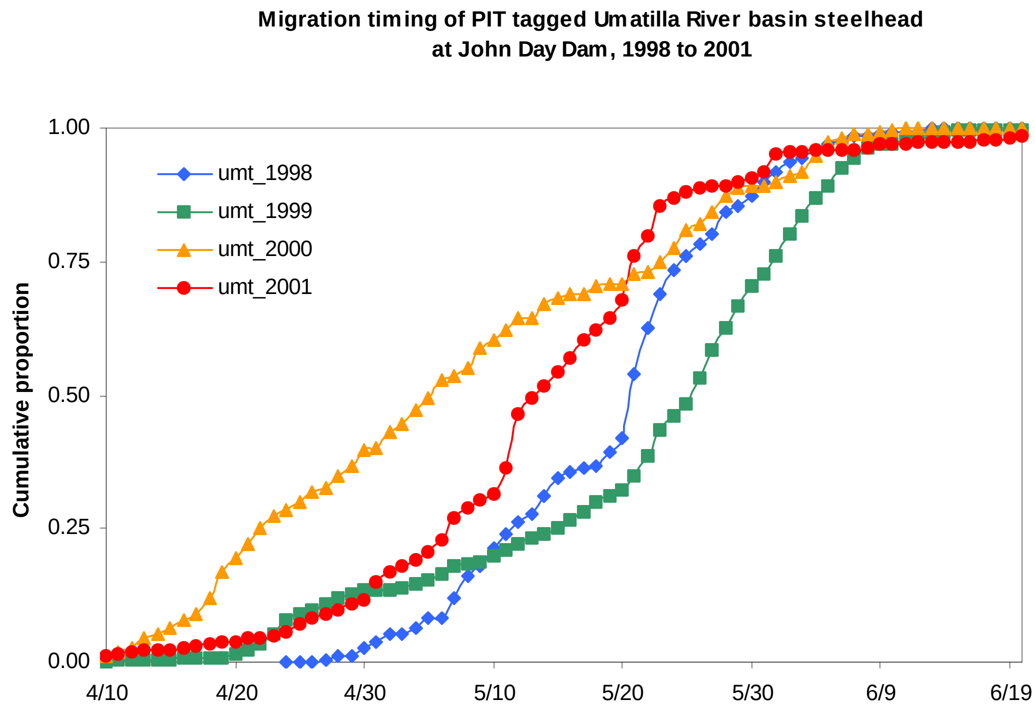


FIGURE E-5. UMATILLA RIVER STEELHEAD AT JOHN DAY DAM.

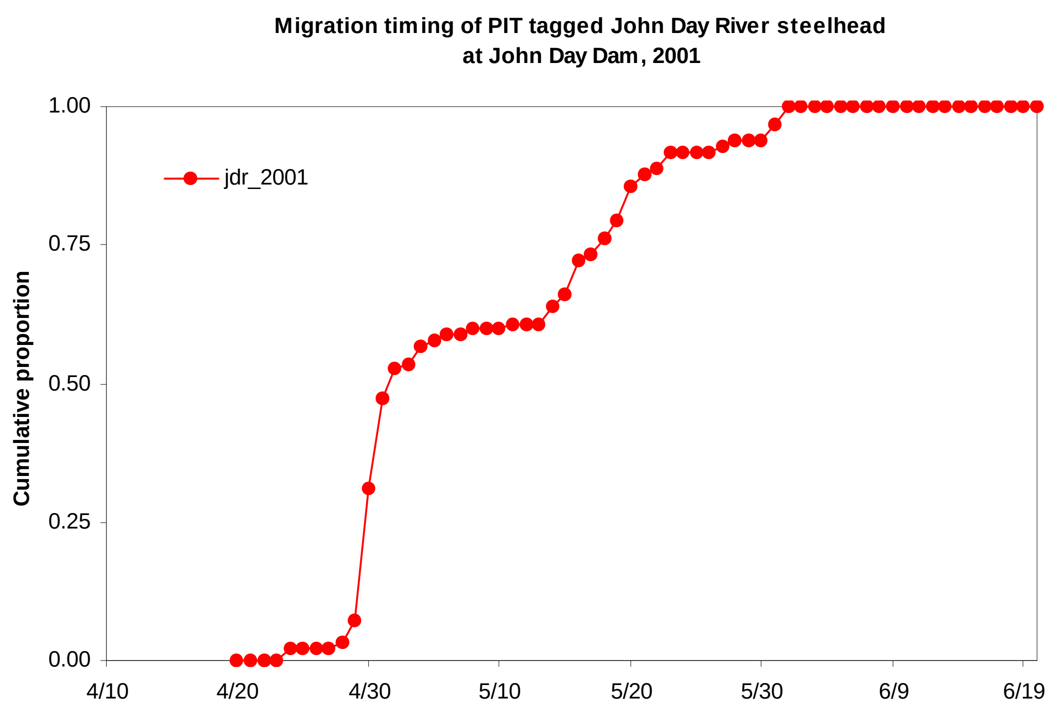


FIGURE E-6. JOHN DAY RIVER STEELHEAD AT JOHN DAY DAM.

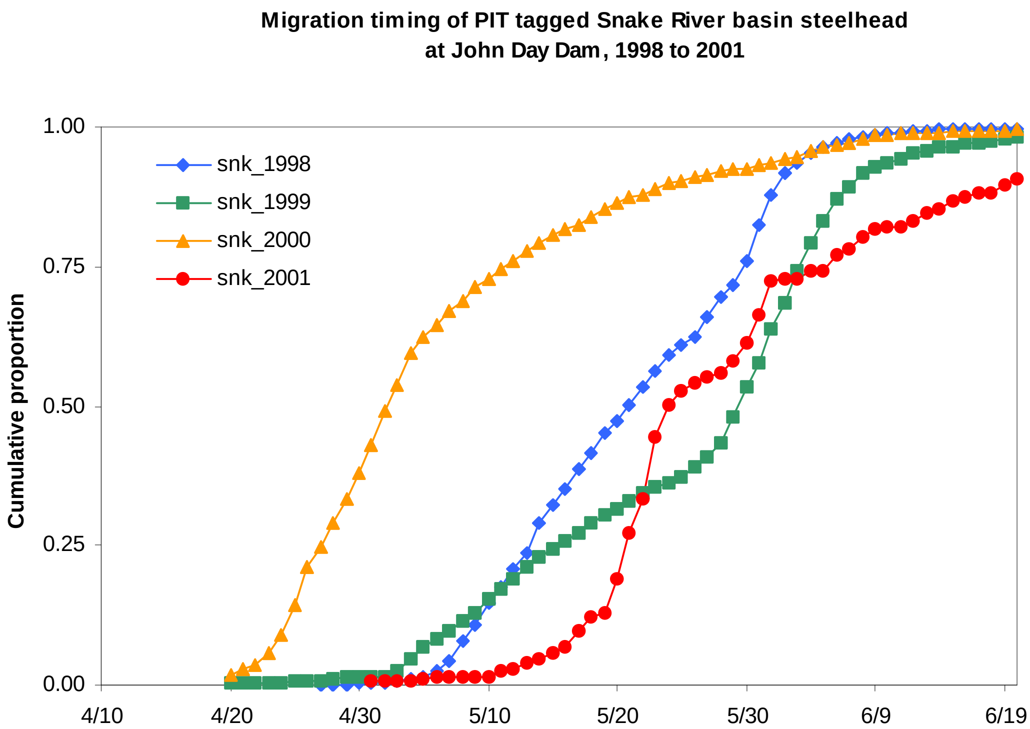


FIGURE E-7. SNAKE RIVER BASIN STEELHEAD AT JOHN DAY DAM.

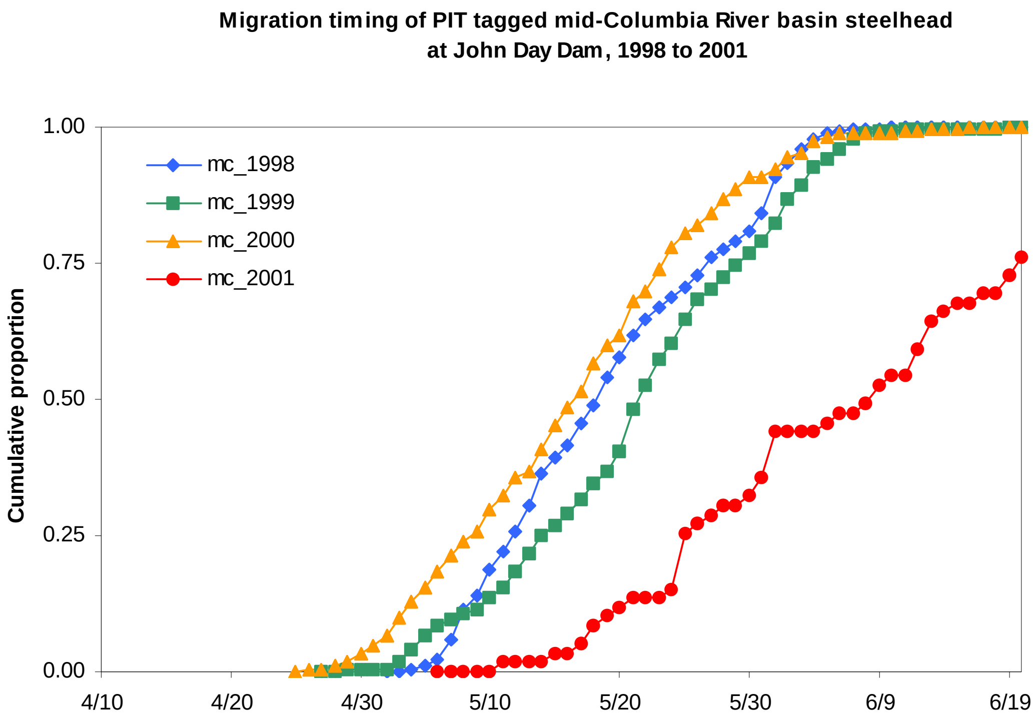


FIGURE E-8. MID-COLUMBIA BASIN STEELHEAD AT JOHN DAY DAM.

APPENDIX F

Travel Time Tables

DISTANCES OVER WHICH TRAVEL TIME IS MEASURED:

Snake River Basin Hatcheries — **Distance to Lower Granite Dam**

Drainage	Hatchery/Release Site	Kilometers	Miles
S.F. Salmon River	McCall H/Knox Bridge	457	284
Salmon River	Rapid River H	283	176
Salmon River	Imnaha A P	209	130
Grand Ronde River		238	148
Clearwater River	Dworshak H	116	72

Snake River Basin Traps — **Distance to Lower Granite Dam**

Drainage	Trap Location	Kilometers	Miles
Salmon River	km 103	233	145
Imnaha River	km 7	142	88
Grande Ronde River	km 5	103	64
Snake River	km 225	52	32

Mid-Columbia River Basin — **Distance to McNary Dam**

Drainage	Hatchery	Kilometers	Miles
Methow River	Winthrop H	454	282
Wenatchee River	Leavenworth H	330	205
Mainstem Columbia River	Wells H	360	224
Mainstem Columbia River	Priest Rapids H	169	105
Mainstem Columbia River	Ringold H	97	60

Key Index Reaches — **Reach Distance**

Reach Location	Kilometers	Miles
Lower Granite Dam to McNary Dam	225	140
Rock Island Dam to McNary Dam	260	161
McNary Dam to Bonneville Dam	236	147

Distance Source: Kilometers of sites obtained from 1998 PIT Tag Specification Document, [editor] Carter Stein, Pacific States Marine Fisheries Commission, March 17, 1998. Miles computed using conversion 0.621 miles per kilometer.

Computation of average flow and average temperature: Flow and temperature data are averaged over the period of days equal to the estimated median travel time commencing on the date of release (or date of passage at upstream dam for the Snake River and lower Columbia River index reaches). The flows and temperatures are indexed at Lower Granite Dam for the release to Lower Granite Dam travel time data. They are indexed at Ice Harbor Dam for the Lower Granite Dam to McNary Dam index reach and at The Dalles Dam for McNary Dam to Bonneville Dam index reach. For the release to McNary Dam travel time data of mid-Columbia River basin released fish, the flows and temperatures are indexed at Priest Rapids Dam.

TABLE F-1. 2001 travel time of PIT tagged wild chinook released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/20	36.6	36.6	36.6	-	-	1	33.5	47.5
3/21	15.7	36.6	39.9	32.2	38.5	17	33.8	47.8
3/22	34.9	37.8	46.7	34.9	46.7	7	35	48
3/23	16.9	34.1	36.5	28.8	36.5	14	33.3	47.4
3/26	15.7	33.6	44.1	32.3	34.5	20	35.6	47.1
3/27	24.7	31.8	73	30.5	35.5	20	34.8	46.9
3/28	24.8	32.5	42.5	29.4	34.5	16	35.8	47.4
3/29	20.2	30.2	48.6	28.4	37	22	34.3	47
3/30	24.8	30.6	45.8	27.4	32.5	22	35.5	47.5
4/2	32.5	32.5	32.5	-	-	1	38.4	48.2
4/3	16.8	24.5	38.5	21.7	27.8	9	33.5	47.3
4/4	17.5	24	26.4	-	-	5	33.3	47.4
4/5	16.4	20.5	23.2	-	-	5	31.5	47.2
4/6	16.8	23.3	28.6	-	-	4	34.2	47.8
4/9	12.5	18.4	33.6	16.5	19	20	32.3	47.8
4/10	15	18.4	30	16.7	25.4	17	33.6	48.2
4/11	13.8	15.7	23.5	13.8	23.5	8	32.1	48.1
4/12	12.7	16.4	28.8	15.8	17.2	23	34.1	48.5
4/13	12.3	15.5	24	13.8	17.7	19	36	49
4/16	10	13.6	30.6	11.6	24	16	38.8	50.1
4/17	9.3	12.3	25.2	11.5	12.9	17	38.6	50.1
4/18	8.9	11.6	57	10.5	12.7	24	40.5	50.6
4/19	9.3	12.4	30.4	11	15.8	22	43.2	51
4/20	8.3	10.8	27.5	9.9	11.9	66	44.2	51.2
4/23	6.5	11.3	32.6	9.8	12.1	95	49.5	51.7
4/24	6.1	10.6	26	9.9	11	105	50.8	51.6
4/25	6.2	9.8	19.8	9.5	10.4	95	52.6	51.6
4/26	5.5	10.4	28.8	9.3	12.9	96	53.5	51.5
4/27	5.7	11.2	28.7	8.5	12.5	78	53.3	51.1
4/30	5.4	12.5	38.5	12	13.8	94	53.7	51.5
5/1	8	14	35	13.2	14.6	68	56.6	51.7
5/2	7	12.9	47	12.5	13.7	55	55.8	51.6
5/3	7.9	11.7	34.4	11.5	12.5	101	55.5	51.7
5/4	7.2	11.5	46.3	10.7	12.9	46	58.2	51.8
5/7	7.1	8.8	19.6	7.1	19.6	7	61.1	52.4
5/8	6.5	7.6	33.8	6.5	33.8	8	63.1	52.8
5/9	5.5	7.6	8.8	-	-	4	67.4	53.1
5/10	5.1	6.3	18.4	5.9	6.7	23	67.1	53.6
5/11	4.7	6.5	15.7	5.6	10.1	20	73.3	53.4
5/14	3.8	9.6	23.3	4.4	13.1	14	73.3	52.9
5/15	4.8	10.5	12.9	5.9	11.4	9	73.4	53.3

TABLE F-1. 2001 travel time of PIT tagged wild chinook released from the Salmon River trap to Lower Granite Dam.

(con't)

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/16	3.6	10.1	17.8	6.7	11.4	10	72.7	53.3
5/17	9.3	9.6	36	-	-	6	70.5	53.5
5/18	6.3	8.4	10	6.3	10	8	68.9	53.3
5/21	6.4	6.8	22.7	-	-	5	66	55
5/22	4.7	5.2	16	-	-	5	66.5	54.7
5/23	9.5	13.4	17.3	-	-	2	58	57.5
5/24	5.1	7.4	8.1	-	-	4	65.1	57.9
5/25	4.4	8.2	16	-	-	4	61.8	57.7
5/29	6.5	10.1	38.1	-	-	5	48.8	58.6
5/30	5.8	14.3	33.3	5.8	33.3	7	45.1	58.2

TABLE F-2. 2001 travel time of PIT tagged hatchery chinook released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/19	30.5	39.6	44.4	37.5	41.3	34	34.2	47.6
3/20	22.9	39.2	65.3	38.1	39.8	55	34.4	47.7
3/21	17.5	38.1	55.6	37.4	38.5	100	34.4	47.9
3/22	22.5	36.5	56.5	35.2	37.5	69	34.3	47.9
3/23	26.8	36.8	44.3	33.7	37.7	30	35	47.8
3/26	10.4	33.3	60.7	32.7	33.6	107	34.9	46.9
3/27	15.4	32.7	50.2	32	33.7	81	35.5	47.1
3/28	22.8	32.5	43.3	31.8	32.8	58	35.8	47.4
3/29	20.6	31.3	44.2	30.6	31.7	55	35	47.2
3/30	16	30.7	45.7	29.6	31.2	37	35.5	47.5
4/2	18.8	27.7	47.3	26.8	28	93	35.2	47.7
4/3	17.4	26.8	44.7	26.5	27.4	129	35.1	47.8
4/4	19.7	25.6	44.8	24.6	26	44	35	47.9
4/5	20.8	25.6	42.4	24.8	27.1	38	36.2	48.1
4/6	14.6	23.6	40.7	22.7	27.5	24	35	48.1
4/9	16.3	21	36.5	20.5	21.5	123	35.7	48.5
4/10	14.8	20	35.8	19.4	20.8	77	35.8	48.7
4/11	15.4	19.4	34.3	18.8	23.5	45	35.9	48.8
4/12	14.1	18.4	35.1	17.6	18.8	106	36.5	49.1
4/13	12.9	16.9	32.7	15.8	23	25	37	49.3
4/16	10.5	14.8	30.7	14	15.8	96	40.6	50.2
4/17	8.1	15.8	31.8	13.8	20.8	57	43.6	50.6
4/18	9.7	12.9	31.7	12.4	14.5	104	42.5	50.7
4/19	8.6	12.5	27.7	11.8	15.6	59	44.4	51
4/20	8	14.4	25.8	12.4	15.3	55	46.4	51.3
4/23	7.2	16.1	35.1	14.8	19.5	131	48.9	51.1
4/24	6.8	12	33.6	10.9	15.3	68	50.4	51.4
4/25	6.7	14	32.1	11.4	17.5	71	51	51.1
4/26	5.8	14.9	20.9	13.2	17.3	71	52.5	51.2
4/27	6.4	17.4	31.8	15.6	17.6	76	54.8	51.7
4/30	7	14.6	27	14.3	15.3	79	56.5	51.8
5/1	8.6	14.6	23.2	14.3	14.9	81	58.8	51.8
5/2	8.8	13.4	24.5	13.1	13.9	76	55.8	51.6
5/3	8.3	12.6	29.1	12.3	13.1	91	58.1	51.8
5/4	7.3	11.8	22.6	11.5	12.3	62	58.2	51.8
5/7	7	8.6	13.2	8.2	9.6	26	61.1	52.4
5/8	6.5	7.7	17.1	7.5	8.3	31	63.1	52.8
5/9	6.3	6.7	9.6	6.5	8.5	13	64.8	53.2
5/10	4.5	6.7	18.1	5.9	7.4	59	69.7	53.4
5/11	4	6.8	28.3	6.4	7.9	60	73.3	53.4
5/14	4.7	12.7	26.3	5	14.6	11	72.7	53.6
5/15	5.8	11.6	23.3	9.6	15.2	17	72.9	53.5

TABLE F-3. 2001 travel time of PIT tagged wild steelhead released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	28.7	28.7	28.7	-	-	1	38.1	48.5
4/9	12.8	22.2	31.6	-	-	2	37.1	48.7
4/11	9.4	9.4	9.4	-	-	1	28.9	46.2
4/13	10.2	10.2	10.2	-	-	1	30.9	47.6
4/16	8.4	9.2	9.9	-	-	2	32.2	49.1
4/18	7.6	7.9	9.6	-	-	3	34.4	49.8
4/19	7.5	14.4	21.2	-	-	2	45.1	51.1
4/20	7.8	8.4	9.1	-	-	2	38.8	50.7
4/23	6.5	6.5	6.6	-	-	3	45.1	51.8
4/24	5.2	7.5	10.2	-	-	3	50.4	51.8
4/25	6.6	7.3	16	-	-	3	52.8	51.9
4/26	4.5	5.2	13.6	4.6	6.6	12	54.6	52.2
4/27	4	5.6	18.6	5.2	5.7	64	57.3	52.1
4/30	4.4	6.4	18.9	5.7	7.4	71	54.9	51.3
5/1	5	7.4	27.5	6.2	8.3	38	52.7	50.4
5/2	4.7	7	12.5	5.5	8.4	12	50.4	50.2
5/3	4.7	8.1	14.7	7	11.5	29	50.3	50.6
5/4	5.5	7.3	15.7	6.4	10.8	17	49.6	50.5
5/7	4.7	6.8	9.6	-	-	6	54.9	52
5/8	5.8	7.4	8.5	-	-	6	59.6	52.6
5/9	4.2	5.6	6.7	4.2	6.7	7	61.1	53.1
5/10	3.8	5.7	10.3	4.5	6.4	11	67.1	53.6
5/11	4	4.7	5.8	4.2	5.7	10	69.3	53.8
5/14	3.6	3.8	7.1	3.6	7.1	8	82.6	53.2
5/15	3.7	3.9	15.1	3.7	15.1	7	83.5	52.8
5/16	3.7	4.7	10.8	3.7	10.8	7	78	52.3
5/17	4.6	4.8	10.9	-	-	3	72.8	52
5/18	3.8	6.6	13.6	4.6	8.9	10	68.1	53
5/21	4.6	5.6	11.7	4.6	11.7	7	66	54.3
5/22	3.8	6.1	10.6	3.8	10.6	7	66.4	55.4

TABLE F-4. 2001 travel time of PIT tagged hatchery steelhead released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/9	15.9	17	27.7	-	-	3	31.6	47.6
4/10	11.9	13.9	37.7	-	-	3	30.5	47.3
4/11	8.1	16.8	29.7	9.7	18.7	17	33.6	48.3
4/12	8	13	33.7	8.9	18.6	24	31	47.9
4/13	7	16.4	34.5	13.6	18.6	50	36	49
4/16	5.5	10.8	52.1	9.7	12.5	110	34.2	49.4
4/17	4.6	9.7	33.8	8.7	10.8	75	35	49.6
4/18	4.8	9.6	37.8	8.4	9.9	107	37.6	50.1
4/19	4.8	9.5	30.6	8.7	9.9	125	39.9	50.6
4/20	5.8	8.7	36.5	8.1	10.9	75	40.8	50.9
4/23	4.8	7.8	43.2	6.4	11.8	25	47.6	51.8
4/24	4.6	6.8	23	5.7	7.8	36	49.3	51.9
4/25	3.7	5.4	24.6	4.8	6.6	20	49.1	52
4/26	3.5	5.7	44.1	5	7.5	71	55.3	52.1
4/27	3.7	5.8	29.7	5.2	6.8	219	57.3	52.1
4/30	4.2	10.8	40.6	9.6	14.4	83	52.9	51.1
5/1	4.4	10	26.2	8.9	13.6	91	52.7	50.8
5/2	3.8	12.8	69.2	12.6	13.6	86	55.8	51.6
5/3	5.8	11.8	49.5	11.5	12.6	91	55.5	51.7
5/4	5.8	11.5	97.1	10.6	11.8	62	58.2	51.8
5/7	3.9	7.8	31.1	7.5	8.6	75	57.7	52.2
5/8	5.2	7.8	32.6	7.6	8	116	63.1	52.8
5/9	4.5	6.8	19.7	6.7	7.6	71	64.8	53.2
5/10	4.2	6.3	98.8	5.9	7	117	67.1	53.6
5/11	4	6.8	27.4	5.9	7.8	71	73.3	53.4
5/14	3.5	5.8	14.1	5	6.8	60	79.5	52.9
5/15	2.7	5.9	48.6	4.9	7.7	63	78.3	52.6
5/16	3.7	6.8	57.9	5.3	7.8	38	73.8	52.2
5/17	3.9	6.8	47.4	5.7	8.9	58	70.4	52.5
5/18	3.6	8.6	89.4	7.9	8.7	74	68.7	53.6
5/21	5.5	6.6	87.9	5.8	7.2	29	66	55
5/22	3.7	6	82.9	5	10	32	66.4	55.4
5/23	3.6	5	85	3.9	7.9	31	67.5	56
5/24	3.8	5	35	3.8	14.1	10	67.7	57.3
5/25	7.6	14	27.8	7.6	27.8	7	54.3	58.2

TABLE F-5. 2001 travel time of PIT tagged wild chinook released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/27	2.6	4	6.4	2.8	4.3	12	57.1	52.4
4/30	3.5	4.4	9.6	-	-	3	57.7	52
5/1	3.8	8.9	11	-	-	4	52.4	50.6
5/3	13.5	13.5	13.5	-	-	1	60.1	51.8
5/17	2.7	3.2	3.8	-	-	2	78.5	52
5/23	20.7	20.7	20.7	-	-	1	52.1	57.7
6/4	9.8	19.5	29.2	-	-	2	36.6	58.3
6/15	57.1	57.1	57.1	-	-	1	27.4	65.3

TABLE F-6. 2001 travel time of PIT tagged hatchery chinook released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/27	2.6	6.9	30	5.7	7.4	179	56.4	52
4/28	5.4	11.8	39.5	5.4	39.5	8	53.5	51.2
4/29	2.2	6.8	24.8	6	12.6	23	55.4	51.5
4/30	3.9	11	16.5	8.7	14.5	24	52.9	51.1
5/1	3.9	10	24.7	8.1	11.7	31	52.7	50.8
5/2	7.2	9.4	14.5	-	-	4	51.2	50.7
5/3	5.6	11.5	12.9	-	-	5	55.5	51.7
5/4	5.2	10.4	18.1	5.2	18.1	8	53.2	51.5

TABLE F-7. 2001 travel time of PIT tagged wild steelhead released from the Snake River trap to Lower Granite

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/19	2.8	4.9	9.7	3.8	7.5	9	33.2	49.8
4/27	2.5	2.6	2.8	-	-	3	54.3	52.5
4/28	5.5	15.8	26	-	-	2	55.3	51.8
4/29	2.4	3.6	14.2	3.5	4.3	58	59.4	52.4
4/30	2.4	3.2	5.4	2.6	5.3	10	59.6	52.2
5/1	2.4	3.7	103.2	3.6	3.9	319	56.8	51.2
5/2	3.1	4.2	7.8	3.6	4.7	31	52.3	50.6
5/3	3.5	4.8	6.1	4.5	5.7	12	49	49.9
5/4	3	4.6	10.6	3.7	5.2	26	47.9	49.8
5/7	2.5	4.4	20.5	4	4.8	46	50.2	50.8
5/8	2.7	4.5	8.9	3.6	5.5	36	54.2	52.2
5/9	2.6	3.8	12.3	3.5	4.7	43	55.2	52.8
5/10	3.7	5.6	10.1	-	-	4	67.1	53.6
5/11	3.4	3.9	4.7	3.4	4.7	7	64.9	53.8
5/15	2.3	2.6	4.8	2.5	2.7	25	85.5	53
5/16	2.3	2.8	9.6	2.6	3.7	15	84.2	52.5
5/17	2.4	3.5	9.7	2.8	4.5	38	75.3	52
5/18	2.8	4.6	6.8	-	-	6	68.5	52
5/21	2.5	4.4	6.6	3.3	5.6	10	63.8	53.6

TABLE F-8. 2001 travel time of PIT tagged hatchery steelhead released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/19	2.4	4.8	12.1	3.9	6.2	67	33.2	49.8
4/27	2.5	3.2	5	-	-	5	54.3	52.5
4/28	2.5	4.2	14.4	2.9	6.9	22	59.8	52.5
4/29	2.1	3.8	27.6	3.5	4.3	251	59.4	52.4
4/30	1.9	4.4	19.6	3.1	5	55	57.7	52
5/1	2	4.1	24	3.8	4.7	122	56.8	51.2
5/2	2.7	5.9	26.5	5.5	6.8	126	50.5	50.1
5/3	2.5	5.7	16.7	5.4	6.9	80	49.1	50.1
5/4	2.8	5.7	34.1	5.5	6.6	88	48.7	50.1
5/7	2.6	6.3	31.2	5.6	6.8	178	52.6	51.7
5/8	2.5	5.9	33.2	5.7	6.7	202	56.6	52.4
5/9	2.6	5.8	34.5	5.5	6.5	81	61.1	53.1
5/10	3.6	5.6	28.5	5.5	5.7	75	67.1	53.6
5/11	2.7	4.6	8.3	3.8	4.7	62	69.3	53.8
5/15	1.8	3.6	25.6	3	3.7	152	83.5	52.8
5/16	1.8	3.7	23.8	3.1	4.6	69	81	52.4
5/17	2.4	3.8	21.1	3.6	4.6	183	75.3	52
5/18	2.5	4.6	52	3.7	5.8	34	68.5	52
5/21	3.3	5.7	64.9	5.6	5.7	100	66	54.3
5/23	2.8	3.8	81	3.6	4.2	20	67.8	55.2
5/24	2.5	3.4	20.9	2.6	14.7	10	69.1	56
5/29	3.9	15.4	45.7	3.9	45.7	8	46.3	58.3
5/30	2.6	11.2	83.5	7.5	37.2	10	46.4	58.4
6/1	6.2	6.2	6.2	-	-	1	44.7	58.3
6/4	15.3	43.2	71.2	-	-	2	31.2	62
6/5	2.6	8.1	21.8	2.8	11.4	9	41.8	58.1
6/6	4.6	7.4	68	5.8	28.4	17	41.6	58
6/7	20.6	40.4	60.1	-	-	2	30.4	62.2
6/11	1.9	12.5	23.2	-	-	2	33.5	58.2
6/12	1.7	24.2	62.3	4.4	30.6	23	29.8	60.5
6/13	5.2	7.2	16.4	-	-	3	35.7	57.1
6/14	7.6	13.8	20	-	-	2	30.6	59.3
6/15	2.7	7.1	11.5	-	-	2	33	57.9
6/22	23.5	50.8	52	-	-	3	26.5	66.4
6/25	2.9	17.7	51.1	6.3	49.4	9	26.3	64.9

TABLE F-9. 2001 travel time of PIT tagged wild chinook released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/7	38.5	52	69	50.9	53.3	15	32.2	47.5
3/10	32.8	39.2	47.2	-	-	3	31.4	46.6
3/11	42.4	42.5	42.6	-	-	2	31.8	46.8
3/12	32.6	45.8	64.5	-	-	6	32.6	47
3/13	41.4	43.8	46.1	-	-	2	32.5	47
3/14	20.8	40.4	46.1	24.5	44.1	9	32.4	46.8
3/15	30.8	43	45.4	36.4	44.2	20	33	47.3
3/16	21.7	40.4	74.1	39.4	41.5	160	32.6	47.2
3/17	24.3	38.5	46.5	36.3	39.8	73	32.6	47.2
3/18	20.8	36.3	49.5	33.2	38.4	67	32.7	47
3/19	19.5	35.8	63.3	34.2	38.7	68	33	47.2
3/20	9.8	32.7	67.8	31.7	33.8	331	33.2	47.1
3/21	10	34.4	60.3	33.9	35.4	572	33.1	47.5
3/22	14.4	34.1	54.9	33.4	34.6	549	33.1	47.6
3/23	12.8	33.9	53.5	33.3	34.3	500	33.3	47.4
3/24	9.6	31.7	74.4	30.7	32.8	323	33.2	47
3/25	12.7	30.6	50.8	28.4	32.2	136	33.4	46.7
3/27	9.1	30.5	49.6	30	31.1	387	34.1	46.7
3/28	11	30.3	48.9	29.5	30.7	445	33.7	46.8
3/29	11.5	29.2	53.8	27.9	30.3	129	33.5	46.9
3/30	10.7	26.1	42.8	23.9	28.1	67	32.5	46.6
3/31	11.9	24.4	33.8	23.1	26.2	41	31.9	46.5
4/1	11.6	26.2	50.9	25.1	27	173	32.6	47.1
4/2	16.1	25.4	51.1	24.1	26.2	75	32.7	47.1
4/3	12.2	24.3	65	23.3	24.8	136	32.5	47.2
4/4	14.6	24.4	42.8	23.6	24.9	83	33.3	47.4
4/5	13.8	24.1	49.1	23.1	25.9	100	34.2	47.8
4/8	11.9	18.6	34.8	17.8	21.1	48	32	47.6
4/9	12.3	19.3	38	18.6	20	63	33.6	48
4/10	9.6	17.8	27.3	16	18.7	48	33.6	48.2
4/11	12.3	16.3	32.3	15.1	18.3	31	32.1	48.1
4/12	8.3	15.8	39.1	14.6	17.1	96	34.1	48.5
4/13	10.3	15.3	33	14.9	16	77	34.5	48.8
4/14	9.5	14.1	36.8	13	15.1	63	34.9	49
4/15	9.3	13.9	40.6	13.1	14.5	78	36.9	49.5
4/16	10	12.6	49.5	12	13.3	47	37.6	49.9
4/17	7.4	11.7	34.1	11.3	12.1	81	38.6	50.1
4/18	7.6	10.9	28.5	10.4	11.1	167	39.4	50.3
4/19	6.5	10	28	9.7	10.4	133	39.9	50.6
4/20	7.6	10	26.8	9.5	11.6	116	42.1	51.2
4/21	6.1	10.1	53.4	9.5	11	199	45.2	51.5
4/22	5.9	9	36.3	8.1	10.1	121	46.1	51.8
4/23	5.8	9.2	30.1	7.7	12.2	85	48.8	51.8
4/24	4.7	9.5	28	7.2	14.4	41	50.9	51.7

TABLE F-9. 2001 travel time of PIT tagged wild chinook released from the Imnaha River trap to Lower Granite Dam.

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	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/25	4.4	7.6	30.5	5.8	9.4	46	53.1	51.9
4/26	4.5	8.3	28.8	7.9	8.9	133	54.8	51.9
4/27	4.5	11.1	24.2	10.1	11.6	154	53.3	51.1
4/29	6.8	14	18.7	11.7	16	24	54.1	51.6
4/30	8.5	13.9	15.5	-	-	6	54.9	51.7
5/1	7	12.5	28.5	11.1	13	49	54.9	51.5
5/2	7.2	12	23.6	11.3	13.2	26	53.9	51.5
5/3	8.4	11	21.9	10.3	11.3	43	53.4	51.5
5/4	7.5	10.7	32.6	10	12.2	33	55.5	51.7
5/5	5	7.5	32.5	6.6	13.3	10	51.6	51.2
5/6	5.3	8.1	30	7.9	9.1	25	53.9	51.7
5/7	5.6	7.8	24.5	7	11.1	22	57.7	52.2
5/8	5.1	7	19.3	6.1	7.8	10	59.6	52.6
5/9	4	5.6	23.9	5	7.3	19	61.1	53.1
5/10	4.1	5.3	16.1	5	7	21	63	53.5
5/11	3.9	4.9	14.2	4.2	6	29	69.3	53.8
5/12	3.6	4.9	18.5	4.2	5.4	25	74.8	53.7
5/14	7.4	8.1	12.8	7.4	12.8	7	75.5	52.7
5/15	5.2	11.2	17.7	7	16.8	10	73.4	53.3
5/16	6.2	13.4	23.6	6.2	23.6	8	71.2	54.4
5/18	6.1	8.1	25.9	6.1	25.9	8	68.9	53.3
5/22	3.7	12.8	22.8	-	-	4	59.2	57
5/24	4.2	8.6	41.8	6.4	13.5	22	62	57.5
5/25	4.1	7.2	18.9	6.4	11.4	24	63.5	58.4
5/29	6	10.8	13.6	-	-	5	48.6	58.6
5/30	8.3	9	14.8	8.3	14.8	8	47.3	58.5

TABLE F-10. 2001 travel time of PIT tagged hatchery chinook released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/23	17.3	31.8	36.3	-	-	6	33	47.2
3/24	9.7	26.2	45.1	24.5	33.5	48	33.1	46.3
3/25	6.1	29.4	49.7	27.3	32.3	131	33.4	46.4
3/27	16.6	31.4	44.6	29.8	32.3	65	34.1	46.7
3/28	12.8	30.5	49.6	29.4	31.7	115	34.5	47
3/29	12.7	28.8	35.4	21.5	31.7	17	33.5	46.9
3/30	20.1	27.1	32.5	23.2	29.7	14	32.8	46.8
4/1	11.2	26.4	55.5	25.5	27	316	32.6	47.1
4/2	12.2	26.1	43.2	25.1	26.6	127	33.6	47.3
4/3	16.2	25.3	41.7	24.8	25.7	219	33.5	47.3
4/4	22.8	22.8	22.8	-	-	1	32.3	47.2
4/7	13.9	22.3	34.9	13.9	34.9	7	34.2	48
4/8	10.7	20.8	37.6	20.1	21.8	100	34.4	48.1
4/9	11.4	19.7	35.2	18.9	20.3	69	34.8	48.2
4/11	17.7	17.7	17.7	-	-	1	34.9	48.6
4/12	16.7	16.7	16.7	-	-	1	35.5	48.8
4/15	9.9	14.9	33.5	13.6	16.2	32	38	49.8
4/16	9.1	13.4	29.4	11.5	15.6	16	37.6	49.9
4/17	7.8	11.4	27.5	7.8	16	10	36.9	49.8
4/18	8.3	12.8	30.7	12.3	13.7	106	42.5	50.7
4/19	5.1	12	37.1	11.5	12.5	114	43.2	51
4/21	9	13.2	22.1	-	-	5	47.3	51.5
4/22	5.3	13	30.4	11.3	19.4	51	48.3	51.6
4/23	5.3	12.3	32.2	9.2	16	77	49.6	51.5
4/24	5.3	11.8	24.9	10.1	18.2	55	50.4	51.4
4/25	3.5	8.8	23.1	6.7	13.4	28	52.8	51.8

TABLE F-11. 2001 travel of PIT tagged wild steelhead released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/20	18.2	42.7	68.7	18.2	68.7	8	36.8	48.2
3/21	8	42	58.2	29.7	53.6	14	36.8	48.3
3/22	27.2	39.7	64.1	34.3	48.1	9	36.3	48.2
3/23	28.3	35.3	42.6	-	-	5	33.7	47.5
3/24	29.4	41.8	59.5	29.4	59.5	8	38.1	48.1
3/25	16.1	40.8	43.7	-	-	5	38.4	48
3/27	28.5	37	53.2	31.1	49.2	10	38	47.6
3/28	6.4	35.4	51.9	32.9	48.8	19	37.3	47.6
3/29	10.9	32.7	49.5	10.9	49.5	7	36.6	47.6
3/30	21.3	32.8	47.6	30.7	35.5	9	37.2	47.8
3/31	48.1	48.2	48.2	-	-	2	45	49.2
4/1	17.1	23.5	40.3	-	-	5	31.7	46.8
4/2	10.4	22.1	34.5	-	-	3	31.6	46.6
4/3	16.7	27.4	47.8	-	-	6	35.1	47.8
4/4	27	27	27	-	-	1	36.2	48
4/5	13.7	23.9	25.9	-	-	3	34.2	47.8
4/11	13.9	13.9	13.9	-	-	1	30.5	47.7
4/12	8.1	14.6	21.8	9.8	18.2	13	32.6	48.3
4/13	10.2	18.6	35.5	10.2	35.5	8	39.7	49.5
4/14	11.9	15.6	25.9	12.2	22.6	11	37.5	49.5
4/15	5.5	21.8	59.8	15.4	30.6	24	42.6	50
4/16	4.4	13.3	29.9	4.4	29.9	8	37.6	49.9
4/17	4.8	6.8	14.3	4.8	13.5	10	32.8	49.1
4/18	4.8	8.4	33.5	7.6	10	72	34.4	49.8
4/19	4.9	8	28.7	7.5	9.5	71	35.8	50.2
4/20	5.1	8.3	118.3	7.7	8.9	98	38.8	50.7
4/21	4.9	8.6	28.9	7.7	9.8	64	42.9	51.5
4/22	4.8	7.1	29.8	6.8	8.5	45	42.3	51.5
4/23	4.1	6.7	23.6	6.1	8	36	45.1	51.8
4/24	4.5	5.7	15.4	5.1	6.6	27	46.6	51.9
4/25	3.4	4.8	11.9	4.7	4.9	54	49.1	52
4/26	2.9	4.9	24.4	4.8	5.2	151	54.6	52.2
4/27	3.8	5.6	12.4	4.9	7.4	40	57.3	52.1
4/29	16.9	16.9	16.9	-	-	1	58.6	52
4/30	4.6	8	20.6	6.8	10.8	25	52.9	50.8
5/1	4.4	11	26.6	9.7	12.2	173	53	51.1
5/2	4	11.8	68.4	10.2	12.8	124	53.9	51.5
5/3	5.2	10.9	44.4	9.1	11.7	95	53.4	51.5
5/4	3.8	8.3	76.8	7.5	9	95	50.2	50.9
5/5	4.7	7.7	33.1	6.5	11.5	25	51.6	51.2
5/6	3.8	8.2	20.8	7	8.5	118	53.9	51.7
5/7	3.6	6.6	25.5	5.6	7.5	67	54.9	52
5/8	4.3	6.5	50.8	6.2	6.6	87	59.6	52.6
5/9	4.4	5.6	19.9	5.6	5.7	127	61.1	53.1

TABLE F-11. 2001 travel of PIT tagged wild steelhead released from the Imnaha River trap to Lower Granite Dam.

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	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/10	3.7	5.4	17	5.1	5.5	220	63	53.5
5/11	3.2	4.7	27.2	4.6	4.8	193	69.3	53.8
5/12	3.1	4.4	14.9	4.2	4.6	157	72	54
5/13	3.8	4	4.6	-	-	6	78.6	53.6
5/14	3	4.4	32.4	4.2	4.7	114	82.6	53.2
5/15	2.7	4.3	30	4	4.7	129	83.5	52.8
5/22	3.7	4.7	35.4	4.6	5.8	19	66.5	54.7
5/24	3	6	50.9	3.8	8.9	21	66.6	57.6

TABLE F-12. 2001 travel of PIT tagged hatchery steelhead released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/13	18.8	21.7	33.2	-	-	3	41.3	49.7
4/15	6.4	30.5	84.1	22.7	33.5	36	48.4	50.8
4/16	12.6	16.2	33.7	12.6	33.7	7	41.7	50.3
4/17	8.5	15.8	50	-	-	6	43.6	50.6
4/18	7.7	9.2	30.5	7.7	30.5	8	35.6	49.9
4/19	4.7	8.7	33.6	7.8	10.4	50	38	50.4
4/20	6.9	6.9	6.9	-	-	1	36.4	50.5
4/21	4.4	9	26.1	7.1	13.3	25	42.9	51.5
4/22	4	9.4	59.2	8.3	11.1	116	46.1	51.8
4/23	4	8.2	123.2	7.3	9	127	47.6	51.8
4/24	4.7	7.3	27	7	8.8	79	49.3	51.9
4/25	3.4	4.6	27	4.2	5.8	41	49.1	52
4/26	3.5	4.8	26.5	3.8	11.7	14	54.6	52.2
4/27	3.2	6.2	79.9	5.1	8.1	75	57.3	52.1
4/29	6.8	15.9	20.1	8.4	18.7	14	56.6	51.9
4/30	3.8	14.9	97.7	12	15.9	49	56.5	51.8
5/1	4.5	13.6	71	13.1	14.4	227	56.6	51.7
5/2	4.2	13.7	103.5	13	13.9	143	58.2	51.8
5/6	3.9	9.5	38.9	8.7	9.6	137	59.7	52.1
5/7	3.7	8.5	27.5	8.1	8.6	93	61.1	52.4
5/8	4.1	7.6	56.6	6.9	7.7	144	63.1	52.8
5/9	4.7	6.8	98.3	6.7	7	77	64.8	53.2
5/10	3.2	5.2	46.7	5.1	6.5	56	63	53.5
5/11	2.8	5.1	37.5	5	5.2	353	69.3	53.8
5/12	3.3	4.5	26	4.2	5	149	74.8	53.7
5/13	2.8	5	94.8	4.2	5.9	54	79.1	53.3
5/14	3	5.1	59	5	5.7	242	81.4	53
5/15	2.9	5.1	93.1	4.2	5.7	73	80.9	52.7
5/24	2.7	4.7	32.7	3.9	9	28	67.7	57.3
5/25	2.9	13.9	62.1	7.7	29.1	21	54.3	58.2

TABLE F-13. 2001 travel of PIT tagged wild chinook released from the Grand Ronde River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/26	26.7	29.2	31.6	-	-	2	33.5	46.3
3/27	23	27.4	35.8	-	-	4	33.4	46.1
3/28	13.8	21.8	32.1	20.7	25.7	28	32.8	45.5
3/29	12.5	25	30.7	17.2	29.5	9	32.7	46.2
3/30	12.4	21.8	29.9	19.2	26.5	16	32.3	45.8
4/2	18.5	24.6	72.6	22.4	26.9	22	32.7	47.1
4/3	15.3	23.3	32.8	21.5	24.1	42	31.9	47
4/4	14.3	21.8	40.5	20.6	23.1	50	31.7	47.1
4/5	10.7	21	40.8	19.4	23.1	24	31.5	47.2
4/6	15.7	20.1	39.4	17.8	23.8	14	31.3	47.2
4/9	12.4	16.6	21.2	12.7	19.2	11	31.6	47.6
4/10	11.8	16.8	20.4	14.3	19.7	14	32.3	47.9
4/12	10.7	16.5	19.2	14.5	17.1	17	35.5	48.8
4/13	11.8	15.6	18.1	11.8	18.1	8	36	49
4/16	11.4	11.9	13.6	-	-	4	36	49.6
4/17	11.2	11.4	11.6	-	-	3	36.9	49.8
4/18	8.7	10.3	11.4	8.7	11.4	8	37.6	50.1
4/19	7.6	10.5	54.4	9	13.4	9	41.1	50.9
4/20	6.5	9.6	15.4	8.6	10.3	24	42.1	51.2
4/23	6.3	8.3	11.4	6.3	10.3	13	47.6	51.8
4/24	5.9	6.3	6.5	-	-	3	46.6	51.9
4/25	4.5	9.1	14.3	-	-	4	52.8	51.8
4/26	4.6	8.4	20.3	6.8	9.1	28	54.8	51.9
4/27	4.3	7.8	29.9	7.2	11.5	51	55.7	51.8
4/30	7.7	11.6	18.9	9.1	15.3	16	53.1	51.3
5/1	8.8	11.6	14.5	10.3	12.3	16	53.7	51.3
5/2	8.7	11.7	12.9	9.9	12.7	9	53.9	51.5
5/3	6.1	9.5	19.6	7.4	12.4	13	51.8	51.2
5/4	8.4	10.4	10.5	-	-	3	53.2	51.5
5/7	6.5	6.7	8.5	-	-	3	54.9	52
5/10	4.1	5.9	8.4	-	-	5	67.1	53.6
5/11	4.5	4.5	7.9	-	-	3	69.3	53.8
5/14	3.5	6.6	35.2	4.5	9.7	21	77.4	52.8
5/15	3.1	7.5	28.1	4.3	9.5	21	74.5	52.4
5/16	3.8	10	12	5.6	11.4	12	72.7	53.3

TABLE F-14. 2001 travel of PIT tagged hatchery chinook released from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/30	26.5	26.5	26.5	-	-	1	32.8	46.8
4/2	16.3	28.6	56	28.4	29.3	163	36.3	47.8
4/3	12.2	28.4	48	27.4	29.5	161	36.3	47.9
4/9	17.5	25.3	37.8	21.9	31.1	47	39.2	49
4/10	10.4	24.4	40.4	21.6	28.2	58	39.5	49.1
4/12	8.5	20.5	34.6	18.7	24.5	68	39.9	49.4
4/13	8.8	17.9	31.4	16.9	22.5	15	38.6	49.4
4/16	10.3	13.8	25.9	11.6	25.2	13	38.8	50.1
4/17	5.6	15.5	17.6	-	-	5	43.6	50.6
4/18	8.5	12.1	26.4	-	-	4	40.5	50.6
4/19	7.5	11.7	26.5	10.4	15	18	43.2	51
4/20	5.5	11.3	25.4	7	24.4	11	44.2	51.2
4/23	3.7	9.5	23.6	8.5	11.3	107	49.5	51.7
4/24	4	9.5	26.3	8.2	10.8	110	50.9	51.7
4/25	4.2	9.5	30.8	8.5	11.6	87	52.6	51.6
4/26	5.4	13.5	22.3	9.1	16.5	42	52.3	51.1

TABLE F-15. 2001 travel of PIT tagged wild steelhead released from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/10	5.8	5.8	5.8	-	-	1	28	45.3
4/20	7.6	7.6	7.7	-	-	2	38.8	50.7
4/23	3.6	4.6	8.6	4.3	5.7	16	41.2	51.2
4/24	3.4	5.6	20.5	4.3	12.2	9	46.6	51.9
4/25	3.4	4.1	20.5	-	-	5	48	51.6
4/26	2.5	3.4	7.4	3	4.2	15	51.2	51.8
4/27	2.4	3.8	18.5	3.7	4.6	43	57.1	52.4
4/30	2.4	4.6	17.6	4.4	5.3	83	56.4	51.7
5/1	2.7	1.4	37.3	2.7	37.3	30	63.8	51.8
5/7	3.6	5.1	8.1	4.3	5.7	23	51.1	51.3
5/8	2.4	6.1	8.8	3.5	7.2	17	56.6	52.4
5/9	5	5.8	6.6	5	6.6	8	61.1	53.1
5/10	3.3	4.4	11.4	4.4	4.7	24	59.5	53.4
5/11	2.7	4.2	6.6	3.5	4.6	16	64.9	53.8
5/14	2.3	3.6	10.6	3.4	3.7	42	82.6	53.2
5/15	2.3	3.6	10.2	2.9	3.7	54	83.5	52.8
5/16	2.5	3.7	23.1	3.5	4.5	29	81	52.4
5/17	3.5	4.6	20.9	3.8	6.5	14	72.8	52

TABLE F-16. 2001 travel time of PIT tagged hatchery steelhead released from the Grande Ronde River trap to Lower Granite Dam.

	Travel Time			Confidence Limits			Lower Granite	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/9	16.4	16.4	16.4	-	-	1	30.9	47.4
4/10	5.5	13.5	35.6	5.7	18.9	10	30.5	47.3
4/12	3.6	15.2	33.7	12.3	17.7	24	32.6	48.3
4/13	5.6	11	20.5	7.7	17.7	16	31	47.9
4/16	3.9	6.3	8.7	-	-	2	31.6	48.3
4/17	11.7	21.9	32.1	-	-	2	44.7	50.4
4/18	8.2	8.2	8.2	-	-	1	34.4	49.8
4/19	9.5	10.3	11.1	-	-	2	39.9	50.6
4/20	3.7	5.9	9.6	4.6	9.5	9	35.1	50.4
4/23	3.3	5.8	24.4	5.6	6.3	81	43.7	51.4
4/24	2.7	5.5	46.7	5.3	5.7	400	46.6	51.9
4/27	4.6	4.6	4.6	-	-	1	57.5	52.2
4/30	1.8	5.8	39.1	5.3	7.5	240	54.9	51.3
5/1	2.6	7.6	31.4	6.6	8.3	219	52.3	50.4
5/7	2.6	6.8	15.7	5.7	7.7	79	54.9	52
5/8	2.7	6.2	12.2	5.6	7.4	61	56.6	52.4
5/9	3.2	6.2	10.6	5.5	7.5	20	61.1	53.1
5/10	3.7	5.6	29.1	4.7	6.2	36	67.1	53.6
5/11	3.1	4.8	15.4	4.6	5.6	40	69.3	53.8
5/14	2.2	5.5	59.1	4.6	5.8	166	79.5	52.9
5/15	2.3	4.6	28.4	4.4	5.1	218	80.9	52.7
5/16	2.7	5.5	87	4.6	6.5	80	75.4	52.3
5/17	2.7	4.6	15.8	3.4	6.6	22	72.8	52

TABLE F-17. 2001 travel time of PIT tagged yearling chinook released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits			Priest Rapids	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	45.1	49.9	52.1	47.8	51.8	14	66.5	50.7
4/23	14.6	31	47.6	26.8	31.9	50	63.1	51
4/24	16.7	26.7	37.7	18.3	33	17	59.9	50.8
4/25	14	30.1	65.7	28.1	31.8	31	63.3	51.5
4/26	15	29.6	78.9	27.9	30.9	73	63	51.7
4/27	18.3	29.8	80.5	27.8	35.2	38	62.4	52
4/28	14.3	25.8	47	19.9	33.1	12	62.1	51.7
4/29	16.3	25	34.9	-	-	6	61.9	51.8
4/30	17.7	27.5	33.2	17.7	33.2	8	61.6	52.5
5/1	14.8	23.5	24.7	-	-	6	62.4	52.1
5/2	14.6	30	56.1	26.8	38.7	31	64.6	53.3
5/3	16.9	21	38.8	19.7	27.8	10	60.5	52.2
5/4	19.2	20	25.8	-	-	5	60.1	52.4
5/6	16.2	22.3	38.5	17.1	37.1	14	59.5	53.3
5/7	13.8	17.8	24.3	16.6	22.6	12	60	52.9
5/8	15.3	17	30.7	16.2	19.1	17	59.7	53.1
5/9	11.3	19.9	51.8	17.7	24.8	20	59.5	53.9
5/10	13.9	18.9	38.6	16.8	21.6	25	59.7	54.1
5/11	11.5	16.3	54.5	14.2	22.1	21	59.5	53.8
5/12	11.7	19.5	32.1	15.9	21.7	21	64.6	54.7
5/13	11.1	17.8	43.8	13	37.7	12	63.8	54.7
5/14	11.8	16.6	32.8	11.9	24.5	10	65.2	54.8
5/15	10.2	15.8	34.4	11.2	18.1	10	66.6	54.9
5/16	9.7	14.9	47.7	13	24.8	14	67.5	55
5/18	8.5	13.1	31.2	8.5	31.2	7	70.2	55.4
5/19	8.9	18.3	44.8	-	-	5	76.8	55.9
5/20	8.2	12.5	23.3	-	-	4	75.6	56
5/21	9.9	14.6	19.3	-	-	2	80.3	56.2
5/23	10.5	15.7	42.5	12.4	34.8	11	85.2	56.6
5/24	12.2	24.8	50.2	15.4	33.5	15	86.2	56.5
5/25	10.3	18.4	62.7	12.7	26.6	22	86.7	56.7
5/26	10.5	18.6	60.5	12.8	29.1	17	86.6	56.6
5/27	11.7	21.8	36.3	11.7	36.3	8	87.3	56.6
5/28	33.9	33.9	33.9	-	-	1	92	57.5
5/29	7.7	11.9	36.8	10	20.6	17	91.5	56.8
5/30	16.5	16.5	16.5	-	-	1	93	56.5
5/31	7.6	13.6	20.1	-	-	6	93.4	56.6
6/1	6	12.3	33	6	33	8	93.6	56.5
6/2	7.9	16.5	32.7	7.9	32.7	7	92.6	56.4
6/3	10.9	10.9	10.9	-	-	1	94.5	56.4
6/4	11.6	11.6	11.6	-	-	1	95.5	56.3
6/5	7.7	15.4	25.7	7.7	25.7	8	96	56.5
6/6	13.6	17.7	21.8	-	-	2	94.6	57.1
6/26	30.7	36.8	51.5	-	-	3	64.8	64
6/27	27.5	29.8	59.7	-	-	6	66.4	63.8
6/29	17	26.8	39.9	19.8	35.8	9	63.7	64.1
6/30	9	26.8	36.2	-	-	4	62.6	64.5

TABLE F-18. 2001 travel time of PIT tagged subyearling chinook released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits			Priest Rapids	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
6/30	9	26.8	36.2	-	-	4	62.6	64.5
7/1	23.1	32.6	42.7	-	-	3	59.7	64.9
7/2	23.8	25.2	26.7	-	-	2	60.5	65
7/3	20.2	32.8	44.9	20.2	44.9	8	57.4	65.2
7/4	14	21.9	45.8	15.1	36	12	57.2	64.9
7/5	17.3	28.8	42.2	-	-	4	56.4	65.1
7/6	11	27.8	40.2	-	-	5	56.5	65.3
7/7	18.7	31.5	42	19.7	33.8	9	58.8	65.4
7/8	16.7	31.1	45.5	-	-	2	59	65.4
7/9	13.7	27.1	54	23.7	30.7	35	55.9	65.3
7/10	10.9	24.2	59.7	18.5	27.4	90	56	65.3
7/11	8.8	24.9	36.3	16.8	30.6	17	54.9	65.3
7/12	9	25.4	50.4	24.1	27.9	51	55.6	65.4
7/13	13.4	25.4	52.1	21.9	34.9	22	58.1	65.5
7/14	11.9	26.4	46.4	23.6	32.2	20	59.6	65.5
7/15	15.5	23	35.2	21.6	29.8	9	57.8	65.5
7/16	21.6	33.2	57.7	-	-	4	64.8	65.6
7/17	10.5	26.1	51.6	22.8	30.3	40	61.7	65.6
7/18	11.4	23.7	44.7	19.8	38.9	19	61.2	65.7
7/20	15.6	20.6	26.8	-	-	6	60.7	65.8
7/21	15.1	20.9	42.9	17	37	11	61.3	65.9
7/22	14.1	22.4	39.8	16.6	27.8	15	62.5	65.9
7/23	13.6	20.7	44.6	18	25.6	17	63.4	65.9
7/24	14.4	28.2	50.6	21.1	36.7	13	66.5	65.9
7/25	16.2	21.8	38	16.2	38	7	66.7	65.9
7/26	14.7	23.4	32	-	-	2	67.7	65.9
7/27	17.6	19.7	42	17.6	42	7	67.5	65.8
7/29	31.1	31.1	31.1	-	-	1	71.9	65.8
7/30	18.5	29.6	29.9	-	-	3	72.9	65.8
7/31	18	27.4	30.9	-	-	3	72	65.8
8/1	13	18.2	23.5	-	-	2	72.4	65.9
8/2	14	21.3	26.2	-	-	5	72.2	65.9
8/3	12.6	15.9	25.9	-	-	5	73.5	66
8/4	11.7	25.2	26	-	-	4	76.1	65.9
8/5	11.5	19.1	26.7	-	-	2	74.2	66
8/6	20.6	20.6	20.6	-	-	1	76.4	66
8/7	11.4	20	23.4	-	-	6	77	65.9
8/8	8.6	15.6	29.1	-	-	4	74.4	65.9
8/9	16	18.5	27.7	17	20.3	12	76.3	65.9
8/10	13.3	16.7	20.5	13.3	20.5	7	75	65.9
8/11	16.9	17.6	18.6	-	-	4	77.3	65.9
8/12	17.4	17.4	17.4	-	-	1	77.6	65.9
8/13	17	17	17	-	-	1	78.6	65.9
8/15	14.8	14.8	14.9	-	-	2	77.9	65.9
8/16	11.2	13.6	16.1	-	-	2	77.4	65.9
8/17	11.2	13.5	15.8	-	-	2	77.9	65.9
8/18	8.2	14.4	25.7	-	-	3	76.8	65.8
8/20	17.3	17.3	17.3	-	-	1	77.1	65.7
8/23	15.8	15.8	15.8	-	-	1	75.2	65.9

TABLE F-19. 2001 travel time of PIT tagged steelhead released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits			Priest Rapids	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	42.5	47.6	67.6	43.9	57.9	14	65.6	50.4
4/23	10.3	13.6	24.9	-	-	3	68.5	48.8
4/24	11.3	12.2	24	-	-	3	68.8	48.9
4/25	7.7	13	20	-	-	6	67.7	49.3
4/26	11.3	14.8	22.4	-	-	3	66	49.8
4/27	9.9	15.4	22	-	-	6	65	50.1
4/29	10.6	15.8	31.4	-	-	5	61.3	50.8
4/30	9.4	18.2	24.1	-	-	4	58.9	51.2
5/1	8.4	13.4	30.1	8.4	30.1	7	61	50.8
5/2	12.5	33	48.4	28.4	35.5	34	66	53.6
5/3	9.3	13.1	26.3	10.2	22.7	9	57.5	51.4
5/4	8	17.6	60.1	11.8	26.3	17	57.6	52.1
5/6	18.1	25	41.5	-	-	6	63	53.7
5/7	13.2	19.8	33.3	-	-	4	59.5	53.3
5/8	11.6	17.9	31.8	11.6	31.8	8	59.7	53.3
5/9	13.3	17.2	30.6	14.6	21.4	15	59.6	53.4
5/10	10.4	15.4	29.4	13.8	22.9	20	59.9	53.3
5/11	13.5	19.6	20.9	13.5	20.9	7	63.3	54.5
5/12	11.2	19.4	39.7	14.6	29.7	21	63.2	54.6
5/13	12.4	17.7	31.9	13.8	20.8	12	63.8	54.7
5/14	11	14.6	37.5	11.5	32.4	9	61.4	54.5
5/15	9.6	21.5	31.5	15	24.4	19	72	55.4
5/16	9.5	16.7	40.4	15.5	28.1	17	69.4	55.3
5/18	8.7	13	28.7	8.7	19.6	10	70.2	55.4
5/19	6.8	23.2	28.7	17.6	28.1	10	81.8	56.1
5/20	11.6	18.7	22.9	11.8	20.3	11	82.9	56.1
5/21	8.5	17.4	37.7	10.8	34.3	10	82.6	56.3
5/23	8.1	15.6	26.7	10.5	19.5	22	85.2	56.6
5/24	6.8	14.6	51	13.9	22.2	21	85.7	56.7
5/25	11.3	17.4	60.5	14	19.2	24	85.5	56.8
5/26	10.5	17	31.5	12.4	26.3	12	86.9	56.7
5/27	12.4	23	29.7	12.4	29.7	8	88.6	56.6
5/29	10	10	14.1	-	-	3	94.3	56.8
5/30	8.8	19	97.1	8.8	97.1	8	91.6	56.5
5/31	7.4	15.4	25.4	8.6	19.4	10	94.2	56.5
6/1	10.4	16.9	24.9	10.4	24.9	8	91.1	56.5
6/2	9.4	12.9	15.4	-	-	6	94.2	56.4
6/3	13.6	16.8	20	-	-	2	94.2	56.5

TABLE F-20. 2001 travel time of PIT tagged sockeye released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits			Priest Rapids	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/24	21.4	25.8	30.3	-	-	2	59.8	50.7
4/26	17.3	24.9	43.8	-	-	3	59	51
4/28	11.9	11.9	11.9	-	-	1	65.9	49.9
5/1	16.9	17.2	17.6	-	-	2	58.4	51.3
5/2	18.3	28	40.1	24.6	29.2	19	62.6	53.1
5/4	26.4	26.4	26.4	-	-	1	62.1	53.3
5/11	12.4	13	13.6	-	-	2	58.5	53.3
5/13	12.2	12.2	12.2	-	-	1	60.4	53.7
5/19	6.4	6.4	6.4	-	-	1	72.5	54.4
5/20	6.1	7.2	8.4	-	-	2	71.3	55.1
5/21	10.3	10.6	11	-	-	2	78.3	56.1
5/23	7.1	7.5	9.3	7.1	8.5	9	75.5	56.4
5/24	6.2	7.5	20.9	6.8	8.5	28	77.1	56.8
5/25	5.9	6.3	7.5	-	-	5	73	56.8
5/26	5.2	6.8	18.7	5.6	8.3	19	74.7	57.1
5/27	5.4	6.2	11.7	-	-	4	76.9	57.1
5/28	6.9	8.6	10.3	-	-	2	84.2	56.8
5/30	6.7	6.7	6.7	-	-	1	89.5	56.7
6/1	6.6	9.5	9.6	-	-	3	93.4	56.8
6/5	15.6	15.6	15.6	-	-	1	97.2	56.7

TABLE F-21. 2001 travel time of PIT tagged yearling chinook released in the Snake River basin from Lower Granite Dam to McNary Dam (grouped by observation date at Lower Granite Dam).

	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/03	13	24.9	31.2	21.7	28.7	16	112	47.9
04/04	16.5	27.2	39.5	-	-	6	114.5	48.4
04/05	16	27.6	43.1	21.8	38.6	15	116.6	48.8
04/06	16.1	27.1	41.1	24.9	31	19	116.7	48.9
04/07	22.7	32	46.5	26.7	36.8	24	118.4	49.6
04/08	21.6	29.7	46.9	25.4	36.2	21	118.6	49.7
04/09	22	35.8	52.9	32.3	45.3	16	118.4	50.7
04/10	20.5	27.8	51.7	25	32.5	58	119.4	50
04/11	17.8	28.6	68.4	26	33.5	104	118.5	50.1
04/12	15.9	28.6	50.7	25.6	31.9	86	118.3	50.5
04/13	14	27.6	49.2	23.1	33	48	118.1	50.5
04/14	16.1	22.4	44.6	20.6	27.2	64	118.4	50.3
04/15	14.7	23.1	41.5	20.2	25.7	67	120	50.6
04/16	8.7	21.1	48.9	19.6	23.8	88	121.8	50.8
04/17	11.8	20.4	65.8	18.5	23.3	97	122.1	51
04/18	11.3	21.7	50.6	19.9	22.6	235	121.1	51
04/19	11.3	23.4	55.3	21.3	25.3	361	120.3	51.5
04/20	10.5	20.5	55.7	19.5	21.7	327	121	51.4
04/21	10.2	19.9	55.5	19	21.1	537	121.3	51.7
04/22	10.4	20.2	85.9	19.2	21.5	552	122.3	52.1
04/23	8.8	21.2	59	20.4	22.1	513	122.6	52.6
04/24	8.8	20.3	49.2	19.6	21.1	675	123.7	52.8
04/25	8.7	20.6	58.6	20.1	21.2	848	125.3	53.3
04/26	8.1	20.2	106.4	19.8	20.6	1581	125.6	53.5
04/27	8.1	20.1	107.7	19.7	20.4	1445	128	53.7
04/28	8.3	20.1	78.2	19.9	20.3	2946	129.7	54.1
04/29	8.4	19.6	101.7	19.5	19.8	3069	130.9	54.4
04/30	4.9	19.8	71.5	19.5	20.1	2686	130	54.7
05/01	5	21.2	100.2	20.7	21.6	1839	130.1	55.1
05/02	11.4	20.8	87.9	20.4	21.2	1132	130.5	55.6
05/03	11.4	20.4	88.7	19.9	20.7	575	129.2	55.7
05/04	9.5	19.6	74.4	19.2	19.9	754	129.9	55.9
05/05	10.7	19.1	93.4	18.8	19.5	956	129.6	56.1
05/06	10.7	18.5	72.6	18	19.2	342	130.5	56.8
05/07	9.5	17	49.7	15.9	19.3	119	129.5	56.4
05/08	9.6	16.4	67.9	15.7	17.3	217	129.4	56.5
05/09	8.6	16.7	90.6	16.1	17.5	679	131.2	58.3
05/10	7.7	16.4	78.9	15.7	17.1	461	132.1	58.3
05/11	9	15.3	52.4	14.7	15.9	384	134.1	58.3
05/12	6.3	14.7	87.8	14.3	15.2	731	134	58.9
05/13	8	14.1	107.7	13.4	14.6	399	135.2	59.2
05/14	5.8	15.4	113.8	14.8	15.8	1305	136.8	60.3
05/15	4.8	15.1	88.4	14.6	15.4	1522	139.3	60.9
05/16	4	15.2	81.4	14.8	15.4	1102	141.5	61.6
05/17	2.7	7	70.6	6.6	7.5	983	143.1	58.5

TABLE F-21. 2001 travel time of PIT tagged yearling chinook released in the Snake River basin from Lower Granite Dam to McNary Dam (grouped by observation date at Lower Granite Dam).

(con't)

	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/18	2.7	11.9	81.4	9.4	13.1	232	137.7	62.3
05/19	8.5	16.4	90.3	14.6	17.8	136	136.1	62.6
05/20	9.4	17.3	90	14.5	19.2	58	138.5	62.9
05/21	9.9	17.1	64.5	15.1	22.7	33	139.1	63.1
05/22	6.1	15.6	75.7	12.4	22.6	39	139.7	63.5
05/23	8.5	16.4	47.7	13.6	20.5	24	140.6	63.4
05/24	8.4	15.1	69	12.9	20.3	36	139.7	63.5
05/25	9.3	16.1	84.4	13.3	23.9	43	136.8	63.6
05/26	8.9	15.3	62.4	13.2	20.7	81	136.3	63.5
05/27	6.5	19.5	71.7	16.2	20.5	60	136	63.3
05/28	8.5	18.8	89.6	11.4	22.9	23	137	63.2
05/29	13	29.9	61.4	18.2	48.2	17	132.4	63.2
05/30	10.3	33.2	57.5	10.3	57.5	8	129.7	63.2
05/31	14.7	21.5	62.5	16	41.2	10	134.1	62.9
06/01	14.4	40.1	99.1	22.1	44.8	19	120.2	63.4

TABLE F-22. 2001 travel time of PIT tagged steelhead released in the Snake River basin from Lower Granite Dam to McNary Dam (grouped by observation date at Lower Granite Dam).

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/20	11.4	32	54.7	14.2	41.6	9	124.2	53.2
04/21	15.4	27.4	32.9	-	-	6	124.3	52.9
04/22	16.1	25.5	39.4	20.9	31.1	16	125.4	53.1
04/23	16.4	27.6	36.4	-	-	6	126.3	53.9
04/24	9.7	23	49.9	14	27.2	23	126.5	53.3
04/25	11.9	21.8	43.7	14.9	27.8	19	127.2	53.4
04/26	9	21.7	46.8	21.1	25.6	33	129.1	53.9
04/27	9.8	21.3	138.2	19.8	22.2	59	129.5	54
04/28	8.1	21	54.1	19.9	24.8	73	129.2	54.2
04/29	8	19.6	52.7	18.7	21.4	144	130.9	54.4
04/30	9.8	19.3	52.3	18.1	21.6	157	130.6	54.5
05/01	10.6	18.2	50.8	17.8	20.1	152	130.3	54.6
05/02	8.1	19.6	41.9	18.1	20.4	144	129.3	55.2
05/03	12.7	19	44.2	17.2	21.1	83	127.9	55.4
05/04	10.9	18.5	52	17.2	19.6	116	128.7	55.9
05/05	10.6	16.9	77.8	16	17.7	117	126.7	55.7
05/06	10.6	17.2	58.6	14.9	20.3	56	128.3	56.2
05/07	9.1	13.9	37	12.4	15.3	53	125.3	55.9
05/08	8	15	45.8	12.8	18	42	127.9	56.5
05/09	8.2	13.9	35.8	11.3	16.1	60	128.5	57.1
05/10	9.1	15.1	39.8	13.5	17.5	53	131.9	57.7
05/11	6.1	13.4	47.8	12.1	15.3	63	133.2	57.1
05/12	9.2	12.7	48.1	10.4	19.2	34	135.2	57.9
05/13	7.3	14.7	90.8	11.1	18	46	133.6	59.6
05/14	6.1	14.2	44.1	11.2	16.1	128	135.8	59.9
05/15	5.2	15.4	115.5	14	16.1	137	139.3	60.9
05/16	4	15.2	88.9	14.5	15.8	134	141.5	61.6
05/17	3.8	14.5	52.7	13.2	18.6	64	142.6	62.2
05/18	5.5	14	48	13.3	16.2	90	140.8	62.7
05/19	7.9	20.4	37.8	13.6	23.7	41	137.8	62.5
05/20	10.6	21.6	44.3	16.2	27	28	137.4	62.8
05/21	9.1	22.5	50.6	18	34.8	22	139.2	63.2
05/22	8.5	24.8	38.9	12.6	34.6	9	138	63.4
05/23	11.7	21.6	34	11.7	34	8	138.6	63.5

TABLE F-23. 2001 Travel time of PIT tagged subyearling hatchery chinook released in the Snake River Basin from Lower Granite Dam to McNary Dam (grouped by observation date at Lower Granite Dam).

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
06/05	41	45.1	59.3	-	-	5	31.4	62.7
06/06	20.2	40.9	68.6	37.1	49.3	9	31.5	62.4
06/07	32.9	43.7	65.5	38.1	49.5	15	30.8	63
06/08	34.4	40	91	37.6	51	15	30.8	62.7
06/09	35.3	45.5	89	37.2	49.5	15	30	63.8
06/10	31.8	37.4	77.7	34.9	57.3	14	30.1	62.8
06/11	30.7	40.3	81.4	35.8	65.6	21	29.6	63.4
06/12	32.7	36.7	60.7	35.2	39.9	21	29.4	63.2
06/13	32.9	41.1	89.2	35.8	70.7	17	28.9	63.9
06/14	30.1	39.6	74.4	33.3	64.9	14	28.6	64
06/15	29.4	44.5	54.2	-	-	4	28.3	64.9
06/16	59.6	59.6	59.6	-	-	1	27.5	66.3
06/17	34.9	43	63.8	-	-	3	27.7	65.1
06/18	30.1	33	40.6	-	-	6	27.4	63.9
06/19	25.5	47.4	65.6	25.5	65.6	7	27.3	65.9
06/20	26.9	27.7	66.1	26.9	66.1	7	27	63.6
06/21	26.7	37.4	57.2	26.7	57.2	7	27.4	65.2
06/22	25.8	29.8	55.7	-	-	5	26.9	64.3
06/23	21.8	31.8	55.8	21.8	55.8	7	27	64.9
06/24	28.1	35.3	41.4	-	-	6	27.1	65.6
06/25	22.3	28.8	43.2	22.3	43.2	8	27.1	64.9
06/26	20	33.1	52.6	22	45	13	27.4	65.8
06/27	21.1	27.5	54.3	-	-	5	27	65.3
06/28	18.5	24.8	38.9	-	-	6	26.6	65.1
06/29	16.6	18.1	19.6	-	-	2	26.7	64.1
06/30	33.9	42.4	68.1	-	-	3	27	67.4
07/01	12.8	20.4	60.9	12.8	60.9	7	26.8	65.1
07/02	16.9	23.1	41.8	16.9	41.8	7	27.3	66
07/03	12.9	25.8	63.3	22.2	32.7	71	27.6	66.8
07/04	9.8	23.8	71.6	21	28.3	64	27.6	66.8
07/05	11.3	36.7	63	21.2	43.6	23	27.2	68.2
07/06	11.7	33	69.7	19.8	43.7	18	27.2	68.2
07/07	8.8	28.8	52	18.1	36.1	21	27.2	68.2
07/08	11.9	31.4	53.1	23.6	39.4	15	27.1	68.4
07/09	23.2	26.3	29.9	-	-	3	27.2	68.5
07/10	13.3	30.2	66.2	13.6	49.7	11	27.2	68.7
07/11	17.9	32.1	43.4	-	-	5	27.1	69
07/12	23.8	32	40.1	-	-	2	27.1	69.1
07/13	13.1	44.9	46.1	-	-	5	25.8	69.3
07/14	41.9	45.4	49.8	-	-	4	25.8	69.4
07/15	21.2	21.2	21.2	-	-	1	27.1	69.5
07/16	23.6	40.4	52.5	-	-	3	26.1	69.6
07/17	28.4	33.2	47.4	-	-	4	26.7	69.7

TABLE F-24. 2001 travel time of PIT tagged yearling chinook released in any basin from McNary Dam to McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).

	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/23	9.7	24.2	62.8	14.4	31.4	24	125.5	53
04/24	9	21.4	41.9	13.7	35.2	18	123.9	53
04/25	8.9	15.6	47.5	12.8	21.2	21	126.6	52.5
04/26	7.2	22	57.9	13.3	30	13	129.1	53.7
04/27	8.5	15.8	33.2	9	23	14	125.5	53.1
04/28	9.5	20.5	60.5	15.7	27.9	23	129.2	54.1
04/29	6.8	30.2	38	17.6	32.8	36	132.4	57
04/30	7.3	19.4	33.8	15.2	31.5	14	130.6	54.3
05/01	5.5	17.2	46.3	15.2	27.7	46	131	54.2
05/02	7.8	15.8	42.3	14	27	48	130.1	54.4
05/03	7.2	15.3	52.6	13.8	16.8	91	128.4	54.4
05/04	8.3	14.3	49	13	16.8	157	127.6	54.5
05/05	6.9	13.1	49	12.5	13.4	177	126.9	54.6
05/06	7	12.2	36.8	11.8	12.8	153	126.9	54.7
05/07	7.2	11.5	52.6	11.1	12	208	125.7	55
05/08	6.8	11.4	49.5	10.6	12.4	264	125.3	55.1
05/09	5.6	9.7	57.2	9.5	10.3	229	126	55.5
05/10	6.1	10.4	39.8	9.5	11.1	294	126	56.1
05/11	5.9	9.4	38.8	8.6	10.1	316	128.5	56.4
05/12	5.4	9.2	43.3	8.8	9.5	291	129.7	56.8
05/13	5	9.5	39.4	8.8	10.4	261	134.3	57.8
05/14	4.4	10.1	94.3	9.4	11.1	434	139.2	58.5
05/15	4.7	11.1	87.1	10.1	12	685	141.2	59.8
05/16	4.4	11.9	50.9	11	12.5	860	137.8	60.8
05/17	4.4	12.6	96.5	12.1	13.3	555	139.9	61.8
05/18	5.1	12.5	42.7	12	13	697	139.5	62.4
05/19	4.4	10.4	49.4	10	10.6	753	133.8	62.4
05/20	4.3	10.4	37.2	10	10.9	537	137.3	63
05/21	4.7	9.6	38.7	9.2	10.3	617	141.6	63.6
05/22	4.8	9.1	42.6	8.5	9.6	707	142.9	64.1
05/23	4.3	8.7	103.2	8.2	9.3	989	144.7	64.6
05/24	4.2	7.9	94.5	7.6	8.3	1398	143.4	64.8
05/25	4.3	7.4	50.1	7.2	7.5	1240	142	65
05/26	4	6.6	51.3	6.4	6.7	1129	138.5	64
05/27	4	6.5	41.5	6.4	6.7	1077	134.4	63.1
05/28	3.9	6.3	43	6.1	6.5	434	137	62.9
05/29	3.8	6.1	31.5	6	6.2	685	141.8	62.1
05/30	3.7	5.9	47.7	5.8	6.1	504	141.3	61.6
05/31	3.7	5.6	38.8	5.5	5.7	957	140.4	61.3
06/01	3.8	5.9	67.3	5.8	6.1	618	135.1	60.9
06/02	3.8	6.4	39.2	6.2	6.7	390	134.8	60.6
06/03	3.5	6.4	34.6	6	6.7	176	137.5	61.6
06/04	4	7.6	90	7.2	8	152	141.2	62.3
06/05	3.9	6.7	37.8	6.5	7	132	141	62.6
06/06	3.6	6.5	33.2	6.2	6.8	162	139.2	63.1
06/07	4.3	6.4	28.3	5.9	6.6	140	137.8	63.1
06/08	4	6.4	28.3	5.6	6.9	103	136.1	63.6
06/09	3.8	6.6	30.4	6	7.1	79	132	63.4
06/10	4.3	6.6	27.9	6.1	7	58	126.2	63.1

TABLE F-25. 2001 travel time of PIT tagged steelhead released in any basin above McNary Dam from McNary Dam to Bonneville Dam (grouped by observation date at McNary Dam).

	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/05	9.7	16.6	19	9.7	19	7	126.7	55.6
05/06	8.2	11.8	28.7	8.2	28.7	8	126.9	54.7
05/07	8.5	15.6	36.3	-	-	5	128	56.1
05/08	10	19.8	40.6	-	-	6	128.9	58.3
05/09	12	17.7	23.4	-	-	2	130.5	58.4
05/10	8.3	21.5	31.1	-	-	5	134.9	60.1
05/11	9.2	13.4	25.2	-	-	3	133.2	57.8
05/12	6.5	11.5	22	6.5	22	7	134.5	58
05/13	5.8	10.3	31.6	-	-	6	134.3	57.8
05/14	6.1	17.7	23.9	7.6	23	9	140.4	61.2
05/15	7.7	8.4	25	8	12.9	15	140	58.2
05/16	6.1	11.7	42.7	7.6	19.3	27	137.8	60.8
05/17	6.9	9.2	26.4	8.2	15.7	24	142.5	60.6
05/18	5.9	11.8	29.7	9.9	15.7	37	137.7	62.2
05/19	6.1	10.9	47.7	7.6	12.5	29	135.7	62.6
05/20	5.9	9.9	36.9	7.7	16.1	16	137.3	63
05/21	5.6	11.7	62.2	10	13.9	43	141.1	63.2
05/22	6.6	12.3	37.5	10.5	13.4	53	139	63.2
05/23	5.5	11.4	34.5	6.7	13.1	26	138.8	63.4
05/24	5.7	11.5	46.1	6.9	14.7	24	138.6	63
05/25	4.9	7.8	46.3	6.7	10.3	24	139.3	64.1
05/26	5	9.3	23.9	7.2	12.3	20	135.3	63
05/27	4.9	7.7	32.9	6.8	11.7	20	135.4	62.7
05/28	5.3	7.6	15.8	6.2	13.9	10	139	62.3
05/29	7.4	7.6	15.4	-	-	3	143.4	62.1
05/30	5.9	12.4	39	7.8	14.9	13	138.9	62.1
05/31	5	8.2	23.3	6.9	12.2	27	140.6	61.6
06/01	5.7	8.6	27.7	5.9	15.4	17	134.9	61.7

TABLE F-26. 2001 Travel time of PIT tagged subyearling hatchery chinook from McNary Dam to Bonneville Dam (grouped by observation date at McNary Dam).

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
Mid-Columbia River hatchery fish								
06/16	10.5	14.2	20.8	-	-	4	122.8	63.2
06/17	14.7	14.7	14.7	-	-	1	120.7	63.4
06/18	9.2	12.6	16.4	9.2	16.4	7	122.3	63.4
06/19	8.9	16.8	30.3	10.4	27.6	10	117.2	63.8
06/20	8	17.3	48.6	12.4	24.1	21	114.2	63.9
06/21	8	11.6	54.9	8.2	15.7	10	120.4	63.8
06/22	8.6	14.7	57.9	12.1	25.5	13	111.1	63.9
06/23	8.7	14.4	67.1	12.7	16.3	30	109.6	64
06/24	10.2	17.7	71.5	13.4	22.2	42	102.7	64.3
06/25	10.2	20.4	64.6	17.4	22.5	25	97.9	64.8
06/26	9	18.4	54.8	14.5	20.7	30	99.3	64.7
06/27	9.6	20.5	66.7	13.5	32.8	21	95.5	65
06/28	9.6	16.4	47	11.2	27.6	14	96.8	64.8
06/29	8.3	18.6	52.5	13.1	26.2	24	92.8	65
06/30	7	15.1	66.1	14.5	20.4	62	90	64.9
07/01	7.5	13.7	47.8	10.7	16.4	29	89.3	65
07/02	8.3	22.3	59.5	13.9	38.5	26	87.5	65.7
07/03	7.4	16.6	46.7	13.2	36.4	27	86.8	65.4
07/04	13.7	27	52.9	17.4	40.3	15	82.8	66.5
07/05	14.4	22.4	44	-	-	3	83.3	66.3
07/06	9.8	17.4	19.6	-	-	3	82.6	66.1
07/07	10.4	10.9	32.3	-	-	3	83.7	65.8
07/09	12.2	12.2	12.2	-	-	1	84.2	66
07/10	11.5	14.8	18.2	-	-	2	82.8	66.4
07/11	8.9	15.6	35.1	-	-	4	82.7	66.9
07/12	8.7	14.8	58.6	-	-	6	81.5	67
07/13	16.4	28.4	40.5	-	-	2	83.5	68.1
07/14	6.7	11.3	29.6	-	-	5	81.2	66.7
07/15	7.4	12.8	25.7	-	-	5	83	67.3
07/16	15	20.6	22	-	-	3	81.2	68.1
07/17	11.5	18.4	25.2	-	-	2	80.4	68.1
07/18	7.6	17.7	22.5	-	-	5	80.4	68.3
07/19	15.9	33.2	50.4	-	-	2	88.5	69.5
07/20	7.2	9.1	9.7	-	-	4	81.3	67.9
07/21	4.9	19.5	25.4	-	-	3	84.7	68.7
07/23	6.8	15.8	21.4	-	-	4	83	68.8
07/24	7.4	9.3	21.4	-	-	5	79.2	68.6
07/25	9.4	14.6	21.5	-	-	3	84.5	69.1
07/26	6.6	13.6	23	-	-	4	84.8	69.1
07/27	14.3	15.9	34.8	-	-	5	87.4	69.2
07/28	21.6	21.6	21.6	-	-	1	90.9	69.9
07/29	9.8	9.8	9.8	-	-	1	82	69
08/01	10.9	10.9	10.9	-	-	1	91.3	69.5

TABLE F-26. 2001 Travel time of PIT tagged subyearling hatchery chinook from McNary Dam to Bonneville Dam (grouped by observation date at McNary Dam).

(con't)

08/02	6	6	6	-	-	1	86.8	69.3
08/04	14.1	14.1	14.1	-	-	1	98.8	70.4
08/09	24.4	24.4	24.4	-	-	1	98.5	71.1
08/11	21	21	21	-	-	1	98.3	71.2
08/16	8.8	8.8	8.8	-	-	1	92.6	71.3
08/27	9.4	9.4	9.4	-	-	1	96.7	n.a.
Snake River hatchery fish								
07/18	9.8	11.2	12.6	-	-	2	83.2	67.8
07/19	21.8	21.8	21.8	-	-	1	84.4	68.6
07/23	7.6	7.6	7.6	-	-	1	81.1	68.3
07/24	14.8	14.8	14.8	-	-	1	82.9	68.9
07/25	14.9	14.9	14.9	-	-	1	84.5	69.1
07/26	7.9	12.3	16.7	-	-	2	80.1	69.1
07/27	5	8.6	12.3	-	-	2	76.9	68.9
07/29	9.8	9.8	9.8	-	-	1	82	69
07/31	6.8	6.8	6.8	-	-	1	79.9	69.1
08/02	8.2	8.2	8.2	-	-	1	91.5	69.4
08/03	8	8	8	-	-	1	94.3	69.6
08/05	10.5	10.5	10.5	-	-	1	101.4	70.4
08/13	6.7	6.7	6.7	-	-	1	98.1	71.4
08/18	17.7	17.7	17.7	-	-	1	93.8	71.2
08/28	9.9	9.9	9.9	-	-	1	91.2	n.a.
08/29	6.7	6.7	6.7	-	-	1	91.9	n.a.

TABLE F-27. 2001 travel time of PIT tagged hatchery chinook and steelhead released from various locations in the Snake River basin to Lower Granite Dam.

Release Date	Travel Time			Confidence Limits			Ice Harbor Dam	
(median reldate)	Min	Med	Max	Lower	Upper	Number	Flow	Temp
Rapid River Hatchery Chinook								
3/15* (3/29)	n.a.	32.3	96.3	32.2	32.3	29459	34.7	46.7
McCall Hatchery Chinook								
3/26	24.2	48.5	114.8	48.2	48.6	28883	41.4	47.3
Dworshak Hatchery Chinook								
3/28	3.9	30.4	151.1	30.3	30.4	29694	33.5	46.9
Imnaha Acclimation Pond Chinook								
3/21* (4/3)	n.a.	29.1	80.0	28.7	29.2	11131	36.8	47.1
Catherine Creek Acclimation Pond Chinook								
4/2* (4/9)	n.a.	35.4	91.9	35.3	35.5	7704	41.7	47.7
Dworshak Hatchery Steelhead								
4/23-4/26	2.5	6.8	110.0	6.7	7.0	2896	45.1	45.6

* start date of volitional release at Rapid River Hatchery (40 days), Imnaha Acclimation Pond (26 days), and Catherine Creek Acclimation Pond (14 days). For these volitional releases, travel times were referenced to the median date of release by subtracting 14 days at Rapid River, 13 days at Imnaha, and 7 days at Catherine Creek facilities from the intial travel time data. Minimum travel times are not computable for the volitional release groups. Flow and temperature is averaged from initial release date to date found by adding median travel time estimate to projected date of median release.

TABLE F-28. 2001 travel time of PIT tagged yearling and subyearling hatchery chinook released from various locations in the Mid-Columbia River basin.

	Travel Time			Confidence Limits			Priest Rapids Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
Leavenworth Hatchery Yearling Spring Chinook								
4/17	11.3	37	72	36.9	37.2	2888	63.9	50.5
Winthrop Hatchery Yearling Spring Chinook								
4/17	16	36.9	64.5	36.8	37	2228	63.9	50.5
Wells Hatchery Subyearling Summer Chinook								
6/20	14.8	37.8	79.6	36.8	39.1	339	70.8	62.8
Priest Rapids Hatchery Subyearling Fall Chinook								
6/11	4.9	14	46.8	13.6	14.6	467	93.6	57.3
6/15	7.2	13.2	60	12.8	14	451	94.2	58.2
6/19	6.8	13.9	57.8	13.7	14.1	364	96.7	59.2

Temperture is measured at the Priest Rapids Dam downstream dissolved gas temperature gage.

APPENDIX G

Reach Survival Tables

<u>Description of Reach Survival Tables:</u>

Table G-1 presents 2000 survival estimates for yearling chinook and steelhead released from traps on the lower Salmon (103 km above mouth at Twin Bridges), lower Imnaha (6.8 km above mouth), lower Grande Ronde (5 km above mouth), and mainstem Snake (225 km above mouth at Lewiston) rivers through a series of three reservoirs and dams to the tailrace of Lower Monumental Dam. The Seber (1965) and Jolly (1965) methodology and computer program RELEASE (Burnham *et al.* 1987) were used to obtain point estimates of survival for the series of reaches, along with corresponding standard errors of the estimates and the correlation between estimates from adjacent reaches. The three reaches were: trap location to Lower Granite Dam tailrace (denoted **lgr**); Lower Granite Dam tailrace to Little Goose Dam tailrace (denoted **lgs**); and Little Goose Dam tailrace to Lower Monumental Dam tailrace (denoted **lmn**). The product of these three reach estimates produced the entire 3-dam reach survival estimate from the trap's location to Lower Monumental Dam tailrace (denoted **surv_reach**). The associated standard errors (denoted **se_lgr**, **se_lgs**, and **se_lmn** for the respective reach estimates) and covariances derived from the correlation estimates (denoted **corr_lgrlgs** and **corr_lgslmn**) went into computing the variance for the overall reach estimate (denoted **var_reach**) using Meyer's (1975) formulas for propagation of error (*i.e.*, variance of the product of three random variables whose error may be correlated). Normally distributed 95% confidence intervals were computed for the overall reach survival point estimates, and are denoted **ul_reach** for the upper limit and **ll_reach** for the lower limit. Plots of the reach survival estimates with associated 95% confidence intervals are presented in Figures H – 1 through H – 4 for releases from the Salmon, Snake, Imnaha, and Grande Ronde rivers, respectively.

Table G-2 presents 2000 survival estimates for yearling chinook and steelhead from selected hatcheries in the Snake River basin through a series of reservoirs and dams. The first table provides survival estimates and confidence intervals through the 3-dam reach as described in the preceding paragraph. The second table extends the entire reach estimate further downstream to encompass the Lower Monumental Dam tailrace to McNary Dam tailrace reach (denoted **mcn**), and McNary Dam tailrace to John Day Dam tailrace reach (denoted **jda**). The product of the five reach estimates produced the entire 5-reach survival estimate from trap's release location to the tailrace of John Day Dam (again denoted **surv_reach**). Along with the additional standard errors (**se_mcn**, and **se_jda**) and correlations (**corr_lmnmcn**, and **corr_mcnjda**), the variance for the entire 5-reach survival estimate was computed using Meyer's (1975) formulas.

Table G-3 presents 2000 survival estimates for yearling and subyearling chinook, steelhead, and sockeye from several release sites in the Mid-Columbia River basin through one reach consisting of multiple reservoirs and dams. Winthrop Hatchery yearling chinook passed 6 dams, Wells Hatchery subyearling chinook passed 5 dams, Leavenworth Hatchery yearling chinook passed 4 dams, Rock Island Dam releases passed 3 dams, and Priest Rapids Hatchery and Ringold Hatchery passed one dam. The tables present survival estimates (denoted **mcn**) and confidence intervals from release site to tailrace of McNary Dam.

<u>Sources:</u>

Burnham, K.P., D.R. Anderson, G.C. White, C. Bronwnie, and K.H. Pollock, 1987, *Design and* *analysis methods for fish survival experiments based on release-recapture,* American Fisheries Society Monograph 5, 437 pp.

Jolly, G.M., 1965, Explicit estimates from capture-recapture data with both death and immigration – stochastic model, *Biometrika*, 52: 225-247.

Meyer, S.L., 1975, *Data analysis for scientists and engineers*, John Wiley and sons, N.Y., 513 pp.

Seber, G.A.F., 1965, A note on the multiple-recapture census, *Biometrika*, 52: 249-259.

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).

Site	**Snake River trap**					
species/reartype	**Hatchery Chinook**	**Hatchery Steelhead**			**Wild Steelhead**	
dates	**4/27– 5/4**	**4/27– 5/4**	**5/7– 5/11**	**5/15 – 5/21**	**4/27– 5/4**	**5/7– 5/21**
lgr	0.95769	0.93860	0.88484	0.86584	0.97947	0.92214
se_lgr	0.01518	0.01134	0.01492	0.01717	0.01186	0.02055
lgs	0.92245	0.71942	0.67008	0.74415	0.84174	0.78293
se_lgs	0.02711	0.02497	0.03959	0.05995	0.03097	0.03970
lmn	0.84359	0.72570	0.81556	0.65533	0.61654	0.54938
se_lmn	0.04717	0.06487	0.17643	0.16919	0.04455	0.07031
corr_lgrlgs	-0.28863	-0.17137	-0.10634	-0.10537	-0.24413	-0.17455
corr_lgslmn	-0.30350	-0.21571	-0.20660	-0.28043	-0.33585	-0.20424
N	372	875	724	680	540	280
ul_reach	0.82492	0.57517	0.68479	0.62753	0.57675	0.49619
ll_reach	0.66557	0.40488	0.28233	0.21694	0.43987	0.29708
surv_reach	0.74525	0.49003	0.48356	0.42223	0.50831	0.39663
se_reach	0.04065	0.04344	0.10267	0.10474	0.03492	0.05079

Site	**Salmon River Trap**					
species/reartype	**Hatchery Yearling Chinook**					
dates	**3/19 –3/23**	**3/26 –3/30**	**4/2 – 4/6**	**4/9 –4/13**	**4/16 –4/20**	**4/23 –4/27**
lgr	0.65515	0.77752	0.76863	0.87799	0.84916	0.89436
se_lgr	0.02115	0.01934	0.01970	0.01619	0.01704	0.01489
lgs	0.96489	0.93354	0.95225	0.94285	0.92618	0.93901
se_lgs	0.02388	0.02410	0.02558	0.02171	0.02021	0.02142
lmn	0.87775	0.77774	0.90058	0.77748	0.87751	0.80270
se_lmn	0.04093	0.03128	0.04982	0.02832	0.03628	0.03914
corr_lgrlgs	-0.10692	-0.17720	-0.14808	-0.21176	-0.18335	-0.19411
corr_lgslmn	-0.37184	-0.38150	-0.33799	-0.37977	-0.24857	-0.29018
N	549	565	541	555	550	580
ul_reach	0.61242	0.61253	0.73259	0.69047	0.75032	0.73860
ll_reach	0.49732	0.51650	0.58574	0.59673	0.62997	0.60964
surv_reach	0.55487	0.56452	0.65916	0.64360	0.69014	0.67412
se_reach	0.02936	0.02450	0.03746	0.02391	0.03070	0.03290

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).
(Continued)

Site	**Salmon River Trap**					
species/reartype	**Hatchery Chinook**		**Wild Yearling Chinook**			
dates	**4/30 – 5/4**	**5/7 – 5/17**	**3/19 –3/30**	**4/9 – 4/20**	**4/23 –4/27**	**4/30 –5/4**
lgr	0.87290	0.89908	0.81073	0.89473	0.90355	0.87124
se_lgr	0.01661	0.02344	0.02984	0.01972	0.01370	0.01682
lgs	0.92479	0.88449	0.89640	0.91408	0.88413	0.92094
se_lgs	0.02458	0.03759	0.03601	0.02796	0.01967	0.02330
lmn	0.76493	0.78880	0.82049	0.66658	0.76323	0.72533
se_lmn	0.04403	0.06841	0.05917	0.04121	0.03392	0.04182
corr_lgrlgs	-0.21466	-0.33047	-0.14863	-0.13487	-0.14552	-0.16575
corr_lgslmn	-0.28700	-0.28545	-0.23860	-0.25814	-0.20373	-0.25220
N	571	354	205	297	589	505
ul_reach	0.68688	0.73139	0.68940	0.61345	0.66575	0.64888
ll_reach	0.54811	0.52316	0.50317	0.47687	0.55367	0.51508
surv_reach	0.61749	0.62728	0.59629	0.54516	0.60971	0.58198
se_reach	0.03540	0.05312	0.04751	0.03484	0.02859	0.03413

Site	**Salmon River Trap**					
species/reartype	**Hatchery Steelhead**				**Wild Steelhead**	
dates	**4/9 – 4/20**	**4/23 – 5/4**	**5/7 – 5/18**		**4/23 – 5/4**	
lgr	0.86554	0.82163	0.77731		0.90578	
se_lgr	0.01423	0.01444	0.01571		0.02100	
lgs	0.73997	0.71929	0.72218		0.74813	
se_lgs	0.02493	0.03979	0.05646		0.04128	
lmn	0.67923	0.61861	0.77858		0.70257	
se_lmn	0.06144	0.08102	0.20797		0.08255	
corr_lgrlgs	-0.10729	-0.10335	-0.08577		-0.15648	
corr_lgslmn	-0.17055	-0.34589	-0.26733		-0.25408	
N	732	1038	1037		307	
ul_reach	0.51331	0.45425	0.65785		0.58528	
ll_reach	0.35675	0.27693	0.21627		0.36689	
surv_reach	0.43503	0.36559	0.43706		0.47609	
se_reach	0.03994	0.04524	0.11265		0.05571	

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).

(continued)

Site	Grande Ronde River Trap					
species/reartype	**Hatchery Yearling Chinook**				**Wild Chinook**	
dates	**4/2 – 4/3**	**4/9 – 4/20**	**4/23 – 4/26**		**3/28 – 4/13**	**4/18 – 5/3**
lgr	0.76048	0.81539	0.79795		0.90985	0.87455
se_lgr	0.01963	0.02254	0.02757		0.01791	0.02146
lgs	0.95424	0.91644	0.91616		0.92874	0.96709
se_lgs	0.02550	0.02820	0.03961		0.02702	0.02100
lmn	0.83131	0.83344	0.88423		0.92068	0.88737
se_lmn	0.03967	0.04202	0.07442		0.06337	0.05323
corr_lgrlgs	-0.20899	-0.27388	-0.33102		-0.14067	-0.11916
corr_lgslmn	-0.36936	-0.28587	-0.29075		-0.25252	-0.20071
N	601	423	362		321	266
ul_reach	0.66152	0.68854	0.75272		0.88362	0.84380
ll_reach	0.54502	0.55706	0.54009		0.67235	0.65721
surv_reach	0.60327	0.62280	0.64641		0.77799	0.75051
se_reach	0.02972	0.03354	0.05424		0.05389	0.04760

Site	Grande Ronde River Trap					
species/reartype	**Hatchery Steelhead**				**Wild Steelhead**	
dates	**4/23 – 4/26**	**4/30 – 5/4**	**5/7 – 5/17**		**4/23 – 5/1**	**5/7 – 5/21**
lgr	0.88461	0.85434	0.88296		0.90138	0.88814
se_lgr	0.01641	0.01868	0.01542		0.02084	0.02450
lgs	0.68495	0.68684	0.71643		0.82680	0.71017
se_lgs	0.02956	0.04011	0.04915		0.04061	0.05566
lmn	0.89175	0.81653	0.81235		0.73344	0.47242
se_lmn	0.11716	0.12744	0.19597		0.10049	0.08289
corr_lgrlgs	-0.16088	-0.15411	-0.13522		-0.15959	-0.15432
corr_lgslmn	-0.15514	-0.25600	-0.25098		-0.22044	-0.30638
N	601	600	913		307	292
ul_reach	0.68022	0.62214	0.74918		0.69189	0.39672
ll_reach	0.40042	0.33613	0.27858		0.40132	0.19921
surv_reach	0.54032	0.47913	0.51388		0.54661	0.29797
se_reach	0.07138	0.07296	0.12005		0.07412	0.05039

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).
(continued)

Site	Imnaha River Trap					
species/reartype	**Hatchery Yearling Chinook**					
dates	**3/23 – 3/28**	**3/29 – 4/1**	**4/2 – 4/5**	**4/7 – 4/12**	**4/15 –4/19**	**4/20 –4/27**
lgr	0.74713	0.79741	0.79896	0.79320	0.87510	0.82403
se_lgr	0.01839	0.01773	0.01822	0.02483	0.01732	0.02241
lgs	0.95590	0.97233	0.95497	0.97050	0.97908	0.91387
se_lgs	0.01995	0.01914	0.02027	0.02455	0.01869	0.02300
lmn	0.85498	0.89024	0.88933	0.91250	0.90161	0.94851
se_lmn	0.03570	0.03527	0.03363	0.04416	0.03392	0.03612
corr_lgrlgs	-0.15035	-0.19830	-0.17568	-0.17035	-0.25753	-0.25884
corr_lgslmn	-0.30862	-0.31482	-0.33151	-0.31490	-0.30419	-0.15636
N	638	621	577	308	484	378
ul_reach	0.66537	0.74742	0.73336	0.77684	0.83191	0.77949
ll_reach	0.55587	0.63306	0.62373	0.62803	0.71307	0.64907
surv_reach	0.61062	0.69024	0.67855	0.70244	0.77249	0.71428
se_reach	0.02793	0.02917	0.02797	0.03796	0.03032	0.03327

Site	Imnaha River Trap					
species/reartype	**Wild Yearling Chinook**					
dates	**3/14 – 3/18**	**3/19 –3/20**	**3/21**	**3/22**	**3/23**	**3/24 –3/25**
lgr	0.82107	0.87845	0.82688	0.85348	0.80588	0.86387
se_lgr	0.01822	0.01484	0.01388	0.01393	0.01509	0.01476
lgs	0.98372	0.97399	0.96572	0.91610	0.98451	0.92727
se_lgs	0.01972	0.01601	0.01536	0.01630	0.01451	0.01665
lmn	0.82411	0.84825	0.81746	0.86784	0.83718	0.84976
se_lmn	0.03730	0.03078	0.02882	0.02911	0.03133	0.02793
corr_lgrlgs	-0.11497	-0.13142	-0.11717	-0.16743	-0.08610	-0.16299
corr_lgslmn	-0.34287	-0.30023	-0.30840	-0.21596	-0.30676	-0.21718
N	492	551	833	784	735	647
ul_reach	0.72708	0.77975	0.70011	0.72747	0.71601	0.72949
ll_reach	0.60420	0.67176	0.60542	0.62962	0.61242	0.63189
surv_reach	0.66564	0.72575	0.65276	0.67854	0.66422	0.68069
se_reach	0.03135	0.02755	0.02416	0.02496	0.02643	0.02490

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).

(continued)

Site	**Imnaha River Trap**					
species/reartype	**Wild Yearling Chinook**					
dates	**3/27**	**3/28**	**3/29 – 4/1**	**4/2 – 4/5**	**4/8 – 4/14**	**4/15 –4/19**
lgr	0.83434	0.81749	0.83279	0.88052	0.88762	0.92496
se_lgr	0.01659	0.01603	0.01623	0.01509	0.01455	0.01182
lgs	0.96473	0.92640	0.94070	0.94371	0.93152	0.94211
se_lgs	0.01735	0.01666	0.01595	0.01636	0.01753	0.01536
lmn	0.89342	0.84491	0.84113	0.83170	0.84833	0.85190
se_lmn	0.03515	0.02812	0.02707	0.02940	0.02740	0.02701
corr_lgrlgs	-0.12213	-0.15216	-0.13014	-0.15701	-0.16707	-0.22102
corr_lgslmn	-0.28584	-0.20406	-0.20724	-0.20788	-0.26171	-0.23887
N	562	672	594	546	580	690
ul_reach	0.77850	0.68786	0.70712	0.74349	0.74994	0.79050
ll_reach	0.65975	0.59188	0.61078	0.63872	0.65291	0.69421
surv_reach	0.71912	0.63987	0.65895	0.69110	0.70143	0.74236
se_reach	0.03029	0.02448	0.02458	0.02673	0.02475	0.02457

Site	**Imnaha River Trap**					
species/reartype	**Wild Yearling Chinook**					
dates	**4/20 – 4/22**	**4/23 –4/27**	**4/29 –5/12**			
lgr	0.87627	0.88791	0.76267			
se_lgr	0.01471	0.01448	0.01912			
lgs	0.93270	0.91021	0.94048			
se_lgs	0.01687	0.01856	0.02114			
lmn	0.81867	0.83196	0.73720			
se_lmn	0.02763	0.02885	0.03539			
corr_lgrlgs	-0.20313	-0.22165	-0.14319			
corr_lgslmn	-0.21728	-0.24370	-0.25964			
N	638	654	567			
ul_reach	0.71744	0.72154	0.58281			
ll_reach	0.62075	0.62320	0.47475			
surv_reach	0.66910	0.67237	0.52878			
se_reach	0.02467	0.02509	0.02756			

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).
(continued)

Site	Imnaha River Trap					
species/reartype	Hatchery Steelhead					
dates	4/15 – 4/22	4/23 –4/30	5/1 – 5/3	5/6 – 5/9	5/10 – 5/11	5/12 – 5/15
lgr	0.85258	0.85935	0.79575	0.81007	0.84276	0.85507
se_lgr	0.02444	0.01902	0.02149	0.01847	0.01955	0.01879
lgs	0.74408	0.76094	0.68043	0.82778	0.78114	0.75678
se_lgs	0.04361	0.04042	0.05446	0.06070	0.06717	0.06089
lmn	0.64844	0.62922	0.69011	0.67307	0.83019	0.78253
se_lmn	0.08271	0.08228	0.13760	0.11821	0.21764	0.21060
corr_lgrlgs	-0.18647	-0.15437	-0.10535	-0.07918	-0.09298	-0.13468
corr_lgslmn	-0.26073	-0.28477	-0.31362	-0.37795	-0.29934	-0.26959
N	338	526	507	601	527	685
ul_reach	0.51336	0.51376	0.51344	0.59600	0.81494	0.76373
ll_reach	0.30937	0.30915	0.23388	0.30668	0.27811	0.24903
surv_reach	0.41136	0.41145	0.37366	0.45134	0.54652	0.50638
se_reach	0.05204	0.05220	0.07132	0.07381	0.13695	0.13130

Site	Imnaha River Trap					
species/reartype	Wild Steelhead					
dates	3/20 – 4/1	4/15 –4/22	4/23 –4/30	5/1 – 5/4	5/5 – 5/9	5/10 –5/11
lgr	0.71443	0.89410	0.91870	0.85249	0.80542	0.80668
se_lgr	0.03761	0.01648	0.01666	0.01648	0.01746	0.01783
lgs	0.85301	0.86164	0.82349	0.76022	0.86764	0.82660
se_lgs	0.04672	0.02862	0.02978	0.02699	0.02417	0.02568
lmn	0.71914	0.79324	0.87577	0.75193	0.63445	0.65507
se_lmn	0.07577	0.06990	0.08426	0.07027	0.04506	0.05967
corr_lgrlgs	-0.12016	-0.17794	-0.17340	-0.15471	-0.09915	-0.08615
corr_lgslmn	-0.21129	-0.22281	-0.18453	-0.17526	-0.19948	-0.15350
N	164	511	410	643	588	557
ul_reach	0.53895	0.71611	0.78833	0.57788	0.50711	0.51695
ll_reach	0.33756	0.50611	0.53677	0.39674	0.37961	0.35665
surv_reach	0.43825	0.61111	0.66255	0.48731	0.44336	0.43680
se_reach	0.05137	0.05357	0.06417	0.04621	0.03253	0.04089

TABLE G- 1. 2001 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).

(continued)

Site	**Imnaha River Trap**					
species/reartype	**Wild Steelhead**					
dates	**5/12 – 5/15**					
lgr	0.80835					
se_lgr	0.01838					
lgs	0.80528					
se_lgs	0.03575					
lmn	0.64252					
se_lmn	0.07969					
corr_lgrlgs	-0.07820					
corr_lgslmn	-0.24661					
N	540					
ul_reach	0.51864					
ll_reach	0.31785					
surv_reach	0.41825					
se_reach	0.05122					

TABLE G- 2. 2001 survival estimates for Snake River basin hatchery fish to Lower Granite Dam tailrace (lgr), between subsequent dams, and within the entire reach (surv_reach) for reaches extending from hatchery release site to Lower Monumental Dam tailrace and from hatchery release site to John Day dam tailrace.

Hatchery & species	McCall Chinook	Rapid R Chinook	Imnaha R Chinook	Catherine Ck Chinook	Dworshak Chinook	Dworshak Steelhead
lgr	0.67159	0.69212	0.74991	0.52621	0.74899	0.75999
se_lgr	0.00711	0.00367	0.00532	0.01223	0.00389	0.00776
lgs	0.91113	0.94775	0.95175	0.92367	0.93669	0.75700
se_lgs	0.01475	0.00638	0.00764	0.02582	0.00615	0.01249
lmn	0.79201	0.85814	0.89564	0.84682	0.83867	0.74407
se_lmn	0.02506	0.01099	0.01349	0.04682	0.00978	0.02891
mcn	0.64883	0.69794	0.75079	0.65521	0.69319	0.25574
se_mcn	0.03195	0.01456	0.01971	0.05847	0.01273	0.02040
jda	0.84284	0.92995	0.87161	0.75880	0.68588	0.58511
se_jda	0.13350	0.07352	0.08429	0.19227	0.04139	0.18631
corr_lgrlgs	-0.21807	-0.20879	-0.27146	-0.24657	-0.29611	-0.11029
corr_lgslmn	-0.37089	-0.34574	-0.27162	-0.34854	-0.26832	-0.21543
corr_lmnmcn	-0.43110	-0.40401	-0.39372	-0.45200	-0.37044	-0.40040
corr_mcnjda	-0.16897	-0.14345	-0.15688	-0.19666	-0.13465	-0.12551
c-hat	10.00000	2.94193	2.54653	10.00000	3.45036	1.14414
N	55129	55091	20922	20915	55142	4205
REACH SURVIVAL						
Hatchery release site to Lower Monumental Dam tailrace						
surv_reach	0.48464	0.56291	0.63924	0.41160	0.58839	0.42807
se_reach	0.01470	0.00718	0.01001	0.02247	0.00708	0.01698
ul_reach	0.51346	0.57698	0.65886	0.45563	0.60227	0.46135
ll_reach	0.45582	0.54883	0.61963	0.36756	0.57452	0.39479
Hatchery release site to John Day Dam tailrace						
surv_reach	0.26503	0.36535	0.41832	0.20463	0.27975	0.06405
se_reach	0.04144	0.02867	0.04007	0.05087	0.01694	0.02030
ul_reach	0.34626	0.42156	0.49686	0.30434	0.31295	0.10385
ll_reach	0.18380	0.30915	0.33977	0.10493	0.24655	0.02426

TABLE G- 3. 2001 survival estimates for Mid-Columbia River basin fish from release site to McNary Dam tailrace (mcn).

	Leavenworth Hatchery		Winthrop Hatchery	
Species	**Chinook 1's**	**Coho**	**Chinook 1's**	**Coho**
Dates	**4/17**	**4/25**	**4/17**	**4/25**
mcn	0.50065	0.19267	0.42711	0.09566
se_mcn	0.00826	0.01475	0.00910	0.01382
N	7580	8840	7423	8000
ul_reach	0.51683	0.22157	0.44496	0.12275
ll_reach	0.48446	0.16376	0.40927	0.06857

	Wells Hatchery	Priest Rapids H	Ringold Hatchery
Species/age	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**
Dates	**6/20**	**6/11 – 6/19**	**6/20 – 6/21**
mcn	0.21139	0.74555	0.73216
se_mcn	0.02302	0.02484	0.02461
N	6000	2997	3006
ul_reach	0.25651	0.79424	0.78040
ll_reach	0.16627	0.69686	0.68392

	Rock Island Dam		
Species	**Yearling Chinook**		**Sockeye**
Dates	**4/23 – 5/4**	**5/23 – 6/6**	**6/20 – 6/21**
mcn	0.52679	0.57760	0.63590
se_mcn	0.02829	0.06682	0.14573
N	761	506	428
ul_reach	0.58223	0.70856	0.92154
ll_reach	0.47135	0.44664	0.35027

	Rock Island Dam			
Species	**Steelhead**			
Dates	**5/1 – 5/10**	**5/11 – 5/20**	**5/21 – 5/26**	**5/27 – 6/3**
mcn	0.18580	0.23733	0.18420	0.13862
se_mcn	0.02226	0.03631	0.04679	0.11073
N	813	911	1060	945
ul_reach	0.22942	0.30850	0.27591	0.35565
ll_reach	0.14218	0.16616	0.09248	< 0

	Rock Island Dam			
Species	**Subyearling Chinook**			
Dates	**6/26 – 7/8**	**7/9 – 7/12**	**7/13 – 7/18**	**7/20 – 7/27**
mcn	0.27903	0.37647	0.33205	0.22028
se_mcn	0.04248	0.03635	0.04723	0.02869
N	548	1275	1042	745
ul_reach	0.36228	0.44772	0.42463	0.27651
ll_reach	0.19578	0.30522	0.23948	0.16405

TABLE G- 4. 2001 survival estimates for PIT tagged fish from Lower Granite Dam tailrace to McNary Dam tailrace (surv_reach) and between subsequent dams (lgs and lmn). Includes PIT tagged fish detected and returned-to-river at Lower Granite Dam as well as fish first PIT tagged and released from Lower Granite Dam.

	Estimated survival from Lower Granite Dam tailrace					
species/reartype	**Hatchery Yearling Chinook**					
dates	**4/1 – 4/7**	**4/8 – 4/14**	**4/15 –4/21**	**4/22 – 4/28**	**4/29 – 5/5**	**5/6 – 5/12**
lgs	0.87454	0.89218	0.93988	0.97251	0.95765	0.94679
se_lgs	0.02920	0.01624	0.00733	0.00382	0.00300	0.00510
lmn	0.78257	0.87455	0.86713	0.84095	0.85789	0.82499
se_lmn	0.04761	0.02955	0.01375	0.00701	0.00560	0.01078
mcn	0.70821	0.73000	0.74477	0.72264	0.71171	0.71043
se_mcn	0.06896	0.04153	0.01973	0.00926	0.00769	0.01716
corr_lgslmn	-0.33580	0.54965	-0.27271	-0.40179	1.86670	2.11352
corr_lmnmcn	-0.27232	0.71161	-0.34333	-0.37140	1.37256	1.59206
N	272	659	2247	11472	20091	6530
ul_reach	0.57828	0.67021	0.63752	0.60487	0.60873	0.60457
ll_reach	0.39109	0.46898	0.57646	0.57714	0.56071	0.50524
surv_reach	0.48469	0.56959	0.60699	0.59100	0.58472	0.55491
se_reach	0.04775	0.05133	0.01557	0.00708	0.01225	0.02534

	Estimated survival from Lower Granite Dam tailrace					
species/reartype	**Hatchery Yearling Chinook**				**Wild Yearling Chinook**	
dates	**5/13 – 5/19**	**5/20 – 5/26**	**5/27 – 6/2**		**4/15 – 4/21**	**4/22 – 4/28**
lgs	0.93688	0.86190	0.83611		0.96264	0.95465
se_lgs	0.00520	0.02221	0.03790		0.00875	0.00542
lmn	0.75796	0.57398	0.56568		0.86450	0.80896
se_lmn	0.00923	0.03320	0.07175		0.01883	0.01023
mcn	0.61692	0.51356	0.28262		0.73140	0.75455
se_mcn	0.01240	0.05498	0.05089		0.02833	0.01645
corr_lgslmn	1.77615	1.49518	1.89318		-0.25639	-0.30331
corr_lmnmcn	1.34300	1.65585	0.70929		-0.32981	-0.30178
N	12717	1121	553		1152	4425
ul_reach	0.47113	0.35420	0.21845		0.65330	0.60715
ll_reach	0.40505	0.15394	0.04888		0.56405	0.55830
surv_reach	0.43809	0.25407	0.13367		0.60867	0.58272
se_reach	0.01686	0.05109	0.04326		0.02277	0.01246

TABLE G- 4. 2001 survival estimates for PIT tagged fish from Lower Granite Dam tailrace to McNary Dam tailrace (surv_reach) and between subsequent dams (lgs and lmn). Includes PIT tagged fish detected and returned-to-river at Lower Granite Dam as well as fish first PIT tagged and released from Lower Granite Dam.

(continued)

	Estimated survival from Lower Granite Dam tailrace				
species/reartype	**Wild Yearling Chinook**				
dates	**4/29 – 5/5**	**5/6 – 5/12**	**5/13 – 5/19**	**5/20 – 5/26**	**5/27 – 6/2**
lgs	0.94280	0.95158	0.93748	0.88471	0.82906
se_lgs	0.00618	0.00746	0.00848	0.01655	0.02556
lmn	0.79677	0.77304	0.70545	0.56123	0.39961
se_lmn	0.01121	0.01562	0.01572	0.02832	0.03543
mcn	0.71209	0.69027	0.66360	0.46094	0.35720
se_mcn	0.01658	0.02560	0.02695	0.03863	0.05053
corr_lgslmn	-0.31083	-0.22189	-0.26729	-0.24996	-0.28582
corr_lmnmcn	-0.31590	-0.28059	-0.28320	-0.33827	-0.36696
N	4121	1892	2324	1027	774
ul_reach	0.55880	0.54440	0.47336	0.26527	0.14951
ll_reach	0.51104	0.47115	0.40437	0.19246	0.08718
surv_reach	0.53492	0.50777	0.43887	0.22887	0.11834
se_reach	0.01219	0.01869	0.01760	0.01858	0.01590

	Estimated survival from Lower Granite Dam tailrace				
species/reartype	**Hatchery Steelhead**				
dates	**4/22 – 4/28**	**4/29 – 5/5**	**5/6 – 5/12**	**5/13 – 5/19**	**5/20 – 5/26**
lgs	0.85834	0.76283	0.68771	0.69545	0.56484
se_lgs	0.01431	0.00905	0.01479	0.01554	0.02692
lmn	0.71585	0.69721	0.67117	0.73059	0.68422
se_lmn	0.03636	0.01956	0.03996	0.05040	0.12626
mcn	0.32277	0.29717	0.42678	0.26845	0.10726
se_mcn	0.03673	0.01718	0.06654	0.03639	0.02842
corr_lgslmn	-0.17498	-0.25588	-0.19604	-0.27576	-0.22245
corr_lmnmcn	-0.36963	-0.37845	-0.32395	-0.46177	-0.65503
N	1237	5485	2111	5496	2193
ul_reach	0.23953	0.17465	0.25399	0.16820	0.05741
ll_reach	0.15712	0.14145	0.13998	0.10460	0.02550
surv_reach	0.19832	0.15805	0.19699	0.13640	0.04145
se_reach	0.02102	0.00847	0.02908	0.01622	0.00814

TABLE G- 4. 2001 survival estimates for PIT tagged fish from Lower Granite Dam tailrace to McNary Dam tailrace (surv_reach) and between subsequent dams (lgs and lmn). Includes PIT tagged fish detected and returned-to-river at Lower Granite Dam as well as fish first PIT tagged and released from Lower Granite Dam.

(continued)

	Estimated survival from Lower Granite Dam tailrace				
species/reartype	**Wild Steelhead**				
dates	**4/22 – 4/28**	**4/29 – 5/5**	**5/6 – 5/12**	**5/13 – 5/19**	
lgs	0.91167	0.86205	0.78234	0.80933	
se_lgs	0.01751	0.00738	0.01319	0.01134	
lmn	0.71571	0.73636	0.73340	0.61322	
se_lmn	0.04738	0.01746	0.02941	0.02279	
mcn	0.22524	0.27016	0.28908	0.41390	
se_mcn	0.03330	0.01546	0.02267	0.04833	
corr_lgslmn	-0.19423	-0.22463	-0.17636	-0.22331	
corr_lmnmcn	-0.38607	-0.33765	-0.39071	-0.23773	
N	761	5656	1657	2884	
ul_reach	0.18621	0.18960	0.18963	0.25117	
ll_reach	0.10773	0.15338	0.14209	0.15966	
surv_reach	0.14697	0.17149	0.16586	0.20542	
se_reach	0.02002	0.00924	0.01213	0.02334	

TABLE G- 5. 2001 survival estimates from McNary Dam tailrace to Bonneville Dam tailrace (surv_reach) for PIT tagged yearling chinook and from McNary Dam tailrace to John Day Dam tailrace (jda) for PIT tagged yearling chinook and steelhead.

	Estimated survival from McNary Dam tailrace				
Species	**Yearling Chinook (hatchery and wild)**				
dates	**5/1 – 5/10**	**5/11 – 5/15**	**5/16 – 5/18**	**5/19 – 5/21**	**5/22 – 5/23**
jda	0.76596	0.81478	0.76470	0.80799	0.85054
se_jda	0.01946	0.02398	0.02650	0.03410	0.03734
bon	0.51940	0.67223	0.66287	0.65117	0.75676
se_bon	0.06261	0.10638	0.08927	0.10462	0.10008
corr_jdabon	-0.20218	-0.18090	-0.25028	-0.25828	-0.32942
c-hat	1.04980	1.59010	1.82355	1.84740	1.00000
N	12224	15173	17095	14642	11883
ul_reach	0.48990	0.71479	0.63645	0.68620	0.80118
ll_reach	0.30579	0.38064	0.37735	0.36608	0.48612
surv_reach	0.39784	0.54772	0.50690	0.52614	0.64365
se_reach	0.04697	0.08524	0.06610	0.08166	0.08037

TABLE G- 5. 2001 survival estimates from McNary Dam tailrace to Bonneville Dam tailrace (surv_reach) for PIT tagged yearling chinook and from McNary Dam tailrace to John Day Dam tailrace (jda) for PIT tagged yearling chinook and steelhead.

(continued)

	Estimated survival from McNary Dam tailrace				
Species	**Yearling Chinook (hatchery and wild)**				
dates	**5/24 – 5/25**	**5/26 – 5/27**	**5/28 – 5/30**	**5/31 – 6/9**	
jda	0.93217	0.84177	0.93264	0.92681	
se_jda	0.03634	0.02671	0.06247	0.05364	
bon	0.64028	0.80243	0.61009	0.52117	
se_bon	0.07046	0.09637	0.11371	0.13811	
corr_jdabon	-0.35284	-0.26055	-0.35835	-0.21776	
c-hat	1.30170	1.01825	2.14970	3.20845	
N	15821	13703	11886	25778	
ul_reach	0.71730	0.82897	0.76306	0.72788	
ll_reach	0.47641	0.52195	0.37494	0.23817	
surv_reach	0.59685	0.67546	0.56900	0.48303	
se_reach	0.06145	0.07832	0.09901	0.12493	

	Estimated survival from McNary Dam Tailrace	
Species	**Steelhead (hatchery and wild)**	
dates	**5/1 – 5/21**	**5/22 – 6/9**
jda	0.31378	0.38070
se_jda	0.02012	0.05631
bon	0.76814	0.58096
se.bon	0.15675	0.154184
corr_jdabon	-0.23690	-0.54184
c-hat	1.0	1.0
N	2163	3165
ul_reach	0.35321	0.49106
ll_reach	0.27435	0.27033
surv_reach	0.24102	0.22117
se_reach	0.04793	0.04956

APPENDIX H

Hatchery Release Schedule

HATCHERY RELEASES ABOVE BONNEVILLE DAM - 2001 MIGRATION YEAR
FISH PASSAGE CENTER DATA SYSTEM

Colville Tribe

Cassimer Bar Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
SO	1	UN	09/27/00	09/30/00	73,261	42.0	Osoyoos Lake	Okanogan River	1999	100% RV clip.
Cassimer Bar Hatchery Total					**73,261**					

Winthrop Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/27/01	03/27/01	40,765	14.9	Okanogan R	Okanogan River	1999	100% LV clip; Actual rel = Omak Cr (RM 8); acclim 1 wk.
Winthrop Hatchery Total					**40,765**					

Colville Tribe Total	**114,026**

Idaho Dept. of Fish and Game

Clearwater Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	09/21/00	09/21/00	79,735	21.7	Red River Acclim Pd	S Fk Clearwater River	1999	100% LV Clip; .600 PIT tag; Supplemental Rel.
CH	1	SP	09/21/00	09/21/00	105,607	30.0	Crooked R Acclim Pd	S Fk Clearwater River	1999	100% RV Clip; 600 PIT tag; Supplemental Rel.
CH	1	SP	04/12/01	04/12/01	212,648	12.6	Powell Acclim Pd	Lochsa River	1999	106k ad clip; 44k BWT; 62k CWT; 300 PIT tag.
CH	1	SP	03/29/01	04/13/01	84,649	11.8	Crooked R Acclim Pd	S Fk Clearwater River	1999	16k ad clip; 68k CWT w/no clip; 300 PIT tag; 39k rel=3/29.
Spring Chinook Yearling Subtotal					**482,639**					
ST		SU	04/20/01	04/26/01	249,270	7.1	Red River Acclim Pd	S Fk Clearwater River	2000	100k ad clip; 150k no clip; 300 PIT tag.
ST		SU	04/25/01	04/26/01	245,547	7.1	Crooked R Acclim Pd	S Fk Clearwater River	2000	150k ad clip; 69k LV+CWT; 20k CWT only; 76k No clip.
ST		SU	04/20/01	04/26/01	97,540	6.9	Clear Cr	Clearwater Rvr M F	2000	100% ad clip; 20k adLV+CWT.
ST		SU	04/23/01	04/27/01	97,766	7.9	Redhouse (SFk ClearH20 R)	S Fk Clearwater River	2000	100% ad clip; 60k adLV+CWT; 300 PIT tag.
Summer Steelhead Subtotal					**690,123**					
Clearwater Hatchery Total					**1,172,762**					

Magic Valley Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/10/01	04/27/01	430,210	4.7	Little Salmon R	Salmon River	2000	100% ad clip; Rel site = Stinky Springs.
ST		SU	04/09/01	04/10/01	58,346	4.3	Little Salmon R	Salmon River	2000	100% ad clip; 60k LV+CWT; 300 PIT tag; Rel = Stinky Springs.
ST		SU	04/09/01	06/04/01	75,912	4.6	Squaw Cr Acclim Pd	Salmon River	2000	100% ad clip.
ST		SU	04/30/01	05/02/01	169,606	4.3	Squaw Cr Acclim Pd	Salmon River	2000	100% ad clip; 45k CWT - E Fk Salmon - B; 46k Dwor - LV+CWT.
ST		SU	04/26/01	04/27/01	51,810	4.7	E Fk Salmon R	Salmon River	2000	100% ad clip; Rel lower river.
ST		SU	05/04/01	05/07/01	224,338	4.3	Lemhi R	Salmon River	2000	90k ad clip; 70k adLV+CWT; 134k no clip.
ST		SU	05/02/01	05/03/01	98,623	4.5	Yankee Fk (Salmon R)	Salmon River	2000	100% ad clip.
ST		SU	04/16/01	04/17/01	175,385	4.8	Hammer Cr	Salmon River	2000	100% ad clip; 70k adLV+CWT; 300 PIT tag.
ST		SU	04/23/01	04/24/01	76,182	4.8	N Fk Salmon R	Salmon River	2000	100% ad clip; Rel site = Lewis & Clark.
ST		SU	04/19/01	04/19/01	67,410	5.4	Lemhi R	Salmon River	2000	100% adLV+CWT; Rel site = Red Rock.
ST		SU	04/26/01	04/26/01	67,950	4.5	Salmon R Idaho	Salmon River	2000	100% ad clip; Rel in Sect. 16 at Wagonhammer.
ST		SU	04/18/01	04/24/01	156,562	4.8	Shoup Br (Salmon R)	Salmon River	2000	100% ad clip; 70k adLV+CWT; 45k & 50k rel = Eye Hole & Colston Corner.
ST		SU	04/17/01	04/19/01	100,374	4.8	Lemhi R	Salmon River	2000	100% ad clip; 35k adLV+CWT; Rel site = Lemhi Hole.
ST		SU	04/17/01	04/25/01	145,280	4.8	McNabb/Salmon R	Salmon River	2000	100% ad clip; 70k adLV+CWT; 65k rel = Tunnel Rk.
ST		SU	04/24/01	04/25/01	119,640	4.6	Salmon R Idaho	Salmon River	2000	100% ad clip; rel site = Challis & Cottonwood.
Magic Valley Hatchery Total					**2,017,628**					

McCall Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	03/26/01	03/29/01	88,385	19.4	S Fk Salmon R	Salmon River	1999	100% LV clip only; 600 PIT tag; Supplemental Rel.
CH	1	SU	09/07/00	11/02/00	54,232	62.5	Stolle Meadows Acclim Pd	Salmon River	1999	100% CWT; 600 PIT tag.
CH	1	SU	03/26/01	03/29/01	1,076,846	19.4	S Fk Salmon R	Salmon River	1999	100% ad clip; 55k PIT tag; 348k ad+CWT.
McCall Hatchery Total					**1,219,463**					

Niagara Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/14/01	05/05/01	889,995	4.1	Pahsimeroi H	Pahsimeroi River	2000	100% ad clip; 60k adLV+CWT; 300 PIT tag.
ST		SU	03/26/01	04/07/01	579,467	4.7	Hells Canyon Dam	Snake River	2000	100% ad clip; 60k adLV+CWT; 300 PIT tag.
ST		SU	04/08/01	04/13/01	267,079	4.5	Little Salmon R	Salmon River	2000	100% ad clip; 60k adLV+CWT; 300 PIT tag.
ST		SU	04/14/01	05/05/01	194,303	4.2	Little Salmon R	Salmon River	2000	100% ad clip.
Niagara Springs Hatchery Total					**1,930,844**					

Oxbow - Idaho Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	05/16/01	06/19/01	115,220	43.0	Hells Canyon Dam	Snake River	2000	Transf from L. Ferry; 100% ad clip.
Oxbow-Idaho Hatchery Total					**115,220**					

Pahsimeroi Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/15/01	04/26/01	85,962	8.2	Pahsimeroi H	Pahsimeroi River	1999	100% CWT; No fin clip; 500 PIT tag; Supplem rel; 25k BKD group.
CH	1	SP	04/15/01	04/26/01	197,148	8.0	Pahsimeroi H	Pahsimeroi River	1999	100% ad clip; 500 PIT tag; listed as Reserve Fish.
Pahsimeroi Hatchery Total					**283,110**					

Rapid River Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/15/01	04/24/01	736,601	18.8	Rapid River H	Little Salmon River	1999	100% ad clip; 345k ad+CWT 10-36-10...14; 55k PIT tag.
Rapid River Hatchery Total					**736,601**					

Sawtooth Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/18/01	04/18/01	57,134	11.5	Sawtooth H	Salmon River	1999	100% CWT; no fin clip.
Spring Chinook Yearling Subtotal					**57,134**					
SO	0	UN	07/31/00	07/31/00	6,007	80.7	Pettit Lake	Salmon River	1999	100% ad clip.
SO	0	UN	07/31/00	07/31/00	5,986	80.7	Alturas Lake	Salmon River	1999	100% ad clip.
Sockeye Subyearling Subtotal					**11,993**					
SO	1	UN	10/11/00	10/11/00	48,051	42.0	Redfish Lake Cr	Salmon River	1999	100% ad clip;
SO	1	UN	10/11/00	10/11/00	6,067	32.5	Pettit Lake	Salmon River	1999	100% ad clip;
SO	1	UN	10/11/00	10/11/00	6,003	35.6	Alturas Lake	Salmon River	1999	100% ad clip.
SO	1	UN	05/02/01	05/02/01	13,903	9.2	Redfish Lake Cr	Salmon River	1999	Transf - Bonn H; 100% adRV+CWT 9-1-16; -26-38; 1k PIT.
Sockeye Yearling Subtotal					**74,024**					
ST		SU	04/27/01	04/27/01	565,188	4.5	Sawtooth H	Salmon River	2000	Acclimated group; 100% ad clip; 44k adLV+CWT; .2k PIT.
Summer Steelhead Subtotal					**565,188**					
Sawtooth Hatchery Total					**708,339**					

Idaho Fish and Game Total	**8,183,967**

Nez Perce Tribe

Clearwater Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/13/01	04/13/01	23,459	6.4	Meadow Cr	S Fk Clearwater River	2000	Supplemental Rel; unmarked.
ST		SU	04/12/01	04/12/01	24,549	7.5	Mill Cr Bridge	S Fk Clearwater River	2000	Supplemental Rel; Unmarked.
ST		SU	04/16/01	04/16/01	48,823	7.3	Lolo Cr	Clearwater Rvr MF	2000	Supplemental Rel; Unmarked.
Summer Steelhead Subtotal					**96,831**					
CH	1	SP	03/27/01	03/28/01	155,195	13.5	Lolo Cr	Clearwater Rvr MF	1999	100% CWT 61-1-2; no clips.
CH	1	SP	03/29/01	04/02/01	155,140	12.5	Newsome Cr	S Fk Clearwater River	1999	100% CWT 61-1-1 w/no clips.
Spring Chinook Yearling Subtotal					**310,335**					
Clearwater Hatchery Total					**407,166**					

Hagerman Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/02/01	04/09/01	156,612	4.6	Little Salmon R	Salmon River	2000	Unmarked; Supplem. rel = Stinky Springs.
ST		SU	04/06/01	04/09/01	50,557	4.3	Hazard Cr/Little Salmon R	Little Salmon River	2000	No fin clip; Supplem rel group.
ST		SU	05/09/01	05/11/01	137,656	4.2	Yankee Fk (Salmon R)	Salmon River	2000	No fin clips; 300 PIT tag; Supplem rel group.
ST		SU	04/27/01	05/02/01	90,188	5.1	American R	S Fk Clearwater River	2000	No fin clip; 300 PIT tag; Supplem Rel group.
ST		SU	05/02/01	05/07/01	86,441	4.2	Newsome Cr	S Fk Clearwater River	2000	No fin clips; 300 PIT tag; Supplem Rel Group.
Hagerman Hatchery Total					**521,454**					

Kooskia Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	05/10/01	05/10/01	35,000	20.0	Kooskia H	Clearwater Rvr MF	1999	About 240k mortality in pd prior to rel; CWT 61-26-17.
Kooskia Hatchery Total					**35,000**					

Lookingglass Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/29/01	03/29/01	133,883	19.6	Lostine Accim Pd	Wallowa River	1999	100% ad+CWT 9-30-60; 61; 63; 9-31-1..5; 62; 7.9K PIT.
Lookingglass Hatchery Total					**133,883**					

Lyons Ferry Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	FA	04/10/01	04/12/01	103,741	12.0	Pittsburg Landing	Snake River	1999	100% ad+CWT 63-4-79; 100% R Gn Elast. tag; 7.5k PIT tag.
CH	1	FA	04/13/01	04/13/01	101,976	12.0	Cpt John Acclim Pd	Snake River	1999	100% ad+CWT 63-4-78; 100% L Blue Elast tag; 2.5k PIT tag.
CH	1	FA	04/09/01	04/11/01	113,215	12.0	Big Canyon (Clearwater R)	Clearwater Rvr MF	1999	100% ad+CWT 63-4-77; 100% L Gn Elast. tag; 7.5k PIT tag.
Fall Chinook Yearling Subtotal					**318,932**					

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	05/28/01	05/28/01	374,070	84.1	Pittsburg Landing	Snake River	2000	200k CWT 63-2-72; no clips; 2k PIT tag.
CH	0	FA	05/26/01	05/26/01	501,129	49.5	Cpt John Acclim Pd	Snake River	2000	Unmarked Release; 2k PIT tag.
CH	0	FA	05/29/01	05/29/01	499,606	53.3	Big Canyon (Clearwater R)	Clearwater Rvr MF	2000	200k CWT 63-2-71; 300k unmarked; 2k PIT tag.
CH	0	FA	06/13/01	06/13/01	357,362	78.2	Big Canyon (Clearwater R)	Clearwater Rvr MF	2000	Unmarked Release.
CH	0	FA	05/29/01	07/04/01	23,642	50.0	Big Canyon (Clearwater R)	Clearwater Rvr MF	2000	100% PIT tag; 4k rel/wk for 6 wk.
Fall Chinook Subyearling Subtotal					**1,755,809**					

Lyons Ferry Hatchery Total **2,074,741**

McCall Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	09/28/00	09/29/00	124,480	43.6	S Fk Salmon R	Salmon River	1999	100% ad+CWT; 2k PIT tag; Scatter Rel - Weir to Goat Cr; 6 mi d/s.

McCall Hatchery Total **124,480**

Willard Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	03/14/01	03/14/01	286,504	26.7	Lapwai Cr	Clearwater Rvr MF	1999	30k ad+CWT 5-43-38; 30k CWT only 5-43-39; 1k PIT tag.
CO	1	UN	03/16/01	03/16/01	275,688	25.1	Potlatch R	Clearwater Rvr MF	1999	30k ad+CWT 5-43-37; 30k CWTonly 5-43-40; 1k PIT tag.

Willard Hatchery Total **562,192**

Nez Perce Tribe Total **3,858,916**

National Marine Fisheries Service

Lyons Ferry Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	06/01/01	07/06/01	7,500	50.0	Pittsburg Landing	Snake River	2000	100% PIT tag; Rel = 1250/wk for 6 wk.

Lyons Ferry Hatchery Total **7,500**

NMFS Total **7,500**

Oregon Department of Fish and Wildlife

Big Canyon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/11/01	04/12/01	160,621	4.5	Big Canyon Acclim.Pd	Grande Ronde River	2000	Forced Rel from Pds; 100% ad clip; 50k adLV+CWT 9-32-15.
ST		SU	05/10/01	05/11/01	130,214	4.7	Big Canyon Acclim.Pd	Grande Ronde River	2000	Rel from Up&Low Pds; 100% ad clip; 50k adLV+CWT9-32-16; 17.

Big Canyon Hatchery Total **290,835**

Irrigon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	05/04/01	05/04/01	835	4.7	Deer Cr	Grande Ronde River	2000	StSxRb Cross; 100% PIT tag.
ST		SU	04/17/01	04/20/01	100,166	5.2	Big Sheep Cr	Imnaha River	2000	Dir Stream rel; 50k unclip left red elast. tag; 50 k ad clip.
Irrigon Hatchery Total					**101,001**					

LiSheep Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/11/01	04/11/01	159,159	4.2	L Sheep Acclim Pd	Imnaha River	2000	100% ad clip; 50k adLV+CWT 9-32-10.
ST		SU	05/09/01	05/09/01	83,297	4.5	L Sheep Acclim Pd	Imnaha River	2000	100% ad clip; 25k adLV+CWT 9-32-11.
Li Sheep Hatchery Total					**242,456**					

Lookingglass Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/21/01	04/16/01	123,014	16.0	Imnaha Acclim Pd	Imnaha River	1999	100% ad+CWT 9-30-56...59; 21k PIT tag.
Spring Chinook Yearling Subtotal					**123,014**					
CH	0	SP	06/29/00	06/29/00	24,201	71.4	Lookingglass Cr	Grande Ronde River	1999	100% ad+CWT 9-31-14; Subyrlg rel at RM 6.5.
Spring Chinook Subyearling Subtotal					**24,201**					
Lookingglass Hatchery Total					**147,215**					

Oak Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/10/01	04/12/01	60,338	6.2	Hood R	Hood River	2000	100% ad clip.
Oak Springs Hatchery Total					**60,338**					

Round Butte Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/02/01	04/10/01	166,126	4.1	Bel. Pelton Dam	Deschutes River	2000	100% ad+RMax Clip.
Summer Steelhead Subtotal					**166,126**					
CH	1	SP	04/16/01	04/19/01	301,217	8.2	Bel. Pelton Dam	Deschutes River	1999	100% ad+CWT 9-31-16...19; Volit. rel from Ladr - 1; 4..6.
Spring Chinook Yearling Subtotal					**301,217**					
Round Butte Hatchery Total					**467,343**					

Wallowa Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/04/01	04/05/01	344,399	4.4	Wallowa Acclim Pd	Wallowa River	2000	Forced Rel; 100% ad clip; 50k adLV+CWT 9-32-12.
ST		SU	05/02/01	05/03/01	207,120	4.7	Wallowa Acclim Pd	Wallowa River	2000	Forced Rel; 100% ad clip; 50k adLV+CWT9-32-13; 14.
Wallowa Hatchery Total					**551,519**					

ODFW Total	**1,860,707**

Umatilla Tribe

Bonneville Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	FA	03/10/01	03/16/01	213,499	9.7	Thornhollow Acclim Pd	Umatilla River	1999	100% BWT; 25k ad+CWT 9-32-6; _PIT.
CH	1	FA	04/13/01	04/19/01	187,262	9.2	Thornhollow Acclim Pd	Umatilla River	1999	100% BWT; 25k ad+CWT 9-32-7; _PIT.
Bonneville Hatchery Total					**400,761**					

Cascade Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	04/24/01	04/24/01	745,497	13.7	Pendelton Acclim Pd	Umatilla River	1999	26.8k ad+CWT 09-30-08.
Cascade Hatchery Total					**745,497**					

Lower Herman C Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	03/10/01	03/14/01	729,062	17.5	Pendelton Acclim Pd	Umatilla River	1999	250k from Cascade H; 80k ad+CWT 9-30-7; 9; 9-32-1.
Lower Herman C Hatchery Total					**729,062**					

Lookingglass Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/01/01	04/16/01	136,833	19.7	Catherine Cr Acclim Pd	Grande Ronde River	1999	100% ad+CWT 9-31-6...13; 9-32-26; 27; 21k PIT.
CH	1	SP	03/26/01	03/26/01	2,560	13.9	Grande Ronde Acclim Pd	Grande Ronde River	1999	100% ad+CWT 9-31-15; .5k PIT tag.
Lookingglass Hatchery Total					**139,393**					

L White Salmon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/10/01	03/16/01	165,310	13.0	Imeques Acclim Pd	Umatilla River	1999	20k ad+CWT 5-46-60.
CH	1	SP	04/11/01	04/17/01	280,902	12.5	Imeques Acclim Pd	Umatilla River	1999	40k ad+CWT 5-46-59; 61; 100k from Carson NFH.
L White Salmon Hatchery Total					**446,212**					

Umatilla Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	05/21/01	05/24/01	324,710	45.3	Thornhollow Acclim Pd	Umatilla River	2000	100% ad+CWT 9-32-55; 56; _PIT.
Fall Chinook Subyearling Subtotal					**324,710**					
CH	1	SP	03/03/01	03/09/01	336,521	11.4	Imeques Acclim Pd	Umatilla River	1999	100% ad clip; 42% CWT 9-31-52...58; 2k PIT tag.
Spring Chinook Yearling Subtotal					**336,521**					
ST		SU	03/28/01	04/04/01	51,240	4.8	Minthorn Acclim Pd	Umatilla River	2000	100% ad clip; 20k adLV+CWT 9-32-23.
ST		SU	04/23/01	04/26/01	41,403	4.7	Minthorn Acclim Pd	Umatilla River	2000	100% ad clip; 21.5k adLV+CWT 9-32-25.
ST		SU	03/31/01	04/05/01	48,308	5.4	Bonifer Acclim Pd	Umatilla River	2000	100% ad clip; 21.2k adLV+CWT 9-32-24.
Summer Steelhead Subtotal					**140,951**					
CH	0	FA	05/24/01	05/25/01	322,283	33.6	Umatilla R	Umatilla River	2000	100% ad+CWT 9-32-53; 54; .6k PIT tag; Rel - RM 48.
Fall Chinook Subyearling Subtotal					**322,283**					
Umatilla Hatchery Total					**1,124,465**					

Umatilla Tribe Total	**3,585,390**

U.S. Fish and Wildlife Service

Carson Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/19/01	04/21/01	1,608,684	14.9	Carson H	Wind River	1999	15k PIT tag; 75k ad+CWT 5-35-13; 14; -48-38.
Carson Hatchery Total					**1,608,684**					

Dworshak Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/16/01	04/20/01	645,863	6.4	Redhouse (SFk ClearH20 R)	S Fk Clearwater River	2000	100% ad clip; 1.2k PIT.
ST		SU	04/23/01	04/27/01	1,247,550	6.1	Dworshak H	Clearwater Rvr MF	2000	88.5% ad clip; 1.5k PIT; 40k adLV+CWT+FB; 149k CWT & 108k BWT w/no clip.
ST		SU	04/16/01	04/20/01	302,755	6.5	Kooskia H	Clearwater Rvr MF	2000	100% ad clip; 20k adLV+CWT; .6k PIT tag.
Summer Steelhead Subtotal					**2,196,168**					
CH	1	SP	03/28/01	03/28/01	333,120	19.7	Dworshak H	Clearwater Rvr MF		
Spring Chinook Yearling Subtotal					**333,120**					
Dworshak Hatchery Total					**2,529,288**					

Entiat Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/03/01	04/03/01	397,855	12.8	Entiat H	Entiat River	1999	100% ad+CWT 5-49-50; 51; 5-45-28.
Entiat Hatchery Total					**397,855**					

Hagerman Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	03/30/01	05/14/01	141,447	4.5	Sawtooth H	Salmon River	2000	100% ad clip; 60k adLV+CWT 5-48-6; 300 PIT tag; Dir Str. Rel at Weir.
Hagerman Hatchery Total					**141,447**					

Kooskia Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	03/27/01	03/27/01	80,430	20.4	Kooskia H	Clearwater Rvr MF	1999	100% ad clip; 68k ad+CWT; 1k PIT tag.
Kooskia Hatchery Total					**80,430**					

Leavenworth Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/17/01	04/17/01	1,630,089	16.8	Leavenworth H	Wenatchee River	1999	264k ad+CWT 5-44-27..29; -49-11; 12; 7.5k PIT tag.
Leavenworth Hatchery Total					**1,630,089**					

L White Salmon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/19/01	04/19/01	1,016,574	15.9	Little White Salmon H	Little White Salmon River	1999	68k ad+CWT 5-44-7.
Spring Chinook Yearling Subtotal					**1,016,574**					
CH	0	FA	06/21/01	06/21/01	1,937,764	109.2	Little White Salmon H	Little White Salmon River	2000	200k ad+CWT 0501010910.
Fall Chinook Subyearling Subtotal					**1,937,764**					
L White Salmon Hatchery Total					**2,954,338**					

Spring Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	03/08/01	03/08/01	5,314,481	117.7	Spring Creek H	L Col R (D/s McN Dam)	2000	225k ad+CWT 5-45-23.
CH	0	FA	04/16/01	04/16/01	5,255,329	59.9	Spring Creek H	L Col R (D/s McN Dam)	2000	224k ad+CWT 5-45-25.
Fall Chinook Subyearling Subtotal					**10,569,810**					
CH	0	SP	05/02/01	05/02/01	414,794	100.0	White Salmon R	White Salmon River	2000	Thinning Rel - Big White Pds; 100% ad+BWT+CWT.
Spring Chinook Subyearling Subtotal					**414,794**					
Spring Creek Hatchery Total					**10,984,604**					

Willard Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	04/19/01	04/19/01	1,189,708	19.0	Willard H	Little White Salmon River	1999	117k ad+CWT.
Willard Hatchery Total					**1,189,708**					

Winthrop Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/17/01	04/17/01	175,869	13.7	Winthrop H	Methow River	1999	100% ad+CWT 5-45-37..41;52; 5-37-11; 5-36-54; 58; 5-44-8; 46-10; 7.5k PIT tag.
Spring Chinook Yearling Subtotal					**175,869**					
ST		SU	04/11/01	04/30/01	98,834	5.5	Winthrop H	Methow River	2000	100% ad clip.
Summer Steelhead Subtotal					**98,834**					
Winthrop Hatchery Total					**274,703**					

Warm Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	09/28/00	11/15/00	42,921	20.0	Warm Springs H	Deschutes River	1999	100% ad+CWT 5-45-19; 22; 5-50-13.
CH	1	SP	03/22/01	04/18/01	784,744	19.0	Warm Springs H	Deschutes River	1999	100% ad+CWT 5-45-18; 19; 22; 5-49-61; 5-50-13.
Warm Springs Hatchery Total					**827,665**					

U.S. Fish and Wildlife Service Total 22,618,811

Washington Department of Fish and Wildlife

East Bank Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
SO	0	UN	08/28/00	08/28/00	84,466	48.0	Lake Wenatchee	Wenatchee River	1999	Summer/fall rel study; 100% ad+CWT 63-01-92.
Sockeye Subyearling Subtotal					**84,466**					
SO	1	UN	11/01/00	11/01/00	83,489	14.5	Lake Wenatchee	Wenatchee River	1999	100% ad+CWT 63-01-93; Part of rel/timing study.
Sockeye Yearling Subtotal					**83,489**					
CH	1	SU	04/26/01	04/26/01	192,426	8.5	Turtle Rock H	Mid-Columbia River	1999	100% ad+CWT 63-4-70.
CH	1	SU	04/27/01	04/27/01	1,005,554	13.1	Dryden Acclim Pd	Wenatchee River	1999	100% ad+CWT 63-4-74; 75.
CH	1	SU	04/18/01	04/18/01	424,363	10.0	Carlton Acclim Pd	Methow River	1999	100% ad+CWT 63-4-71.
CH	1	SU	04/11/01	04/25/01	630,463	12.8	Similkameen Acclim Pd	Okanogan River	1999	100% ad+CWT 63-4-69.
Summer Chinook Yearling Subtotal					**2,252,806**					

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	04/24/01	05/03/01	33,475	3.7	Chiwawa H	Wenatchee River	2000	100% L. Red VIE; CWT 63-5-73; HxH Cross.
ST		SU	04/24/01	05/03/01	57,716	4.5	Chiwawa H	Wenatchee River	2000	100% L. Green VIE; CWT 63-5-84; HxW Cross.
ST		SU	04/24/01	05/03/01	48,029	4.3	Chiwawa H	Wenatchee River	2000	100% R. Green VIE; CWT 63-5-72; HxW Cross.
ST		SU	04/24/01	05/03/01	45,477	4.6	Chiwawa H	Wenatchee River	2000	100% R. Orange VIE; CWT 63-5-71; WxW Cross.
Summer Steelhead Subtotal					**184,697**					
East Bank Hatchery Total					**2,605,458**					
Klickitat Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CH	1	SP	03/07/01	03/09/01	615,000	7.7	Klickitat H	Klickitat River	1999	100k ad+CWT 63-01-99; 63-02-64.
Spring Chinook Yearling Subtotal					**615,000**					
CO	1	NO	05/01/01	05/18/01	1,296,000	19.1	Klickitat H	Klickitat River	1999	100% ad clip; 45.5k ad+CWT 63-11-58.
Coho Yearling Subtotal					**1,296,000**					
CH	0	FA	05/22/01	05/25/01	1,697,900	66.0	Klickitat H	Klickitat River	2000	100k ad+CWT 63-7-77; 211k ad+CWT 9-32-28.
CH	0	FA	05/29/01	06/29/01	2,152,400	72.0	Klickitat H	Klickitat River	2000	500k BWT; 100k ad+CWT 63-7-78; 1.1 mil rel = 6/27-29.
Fall Chinook Subyearling Subtotal					**3,850,300**					
Klickitat Hatchery Total					**5,761,300**					
Lyons Ferry Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
ST		SU	04/16/01	04/24/01	53,551	3.3	Lyons Ferry H	Snake River	2000	100% ad clip; 20k adLV+CWT 63-11-39+Brand.
ST		SU	03/26/01	04/30/01	102,765	3.1	Dayton Acclim Pd	Touchet River	2000	100% ad clip; 20k adLV+CWT 63-1-15.
ST		SU	05/01/01	05/01/01	36,487	5.9	Dayton Acclim Pd	Touchet River	2000	WxW Cross; 100% CWT 63-13-39 +Ye. Elast. tag; 9.5k rel - 13.5/lb.
ST		SU	04/16/01	04/30/01	121,390	3.0	Tucannon R	Tucannon River	2000	100% ad clip; 20k adLV+CWT 63-10-53+Brand.
ST		SU	04/09/01	04/10/01	60,020	5.8	Tucannon R	Tucannon River	2000	WxW Cross; 100% CWT 63-13-36+Y. Elast. tag; 23k ad clip; rel upper Tuc. R.
ST		SU	04/16/01	04/24/01	103,980	3.0	Walla Walla R	Walla Walla River	2000	100% ad clip; 20k adLV+CWT 63-11-40.
ST		SU	03/26/01	04/24/01	215,584	5.0	Cottonwood Acclim Pd	Grande Ronde River	2000	100% ad clip; 40k adLV+CWT 63-2-81+Brand.
Summer Steelhead Subtotal					**693,777**					
CH	1	FA	04/01/01	04/20/01	338,757	8.7	Lyons Ferry H	Snake River	1999	100% ad+CWT+LRed Elast. tag.
Fall Chinook Yearling Subtotal					**338,757**					
Lyons Ferry Hatchery Total					**1,032,534**					

Methow Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CH	1	SP	04/17/01	04/20/01	180,775	10.0	Methow H	Methow River	1999	100% ad+CWT 63-3-77; 80.
CH	1	SP	04/17/01	04/20/01	67,408	9.5	Twisp R	Methow River	1999	100% ad+CWT 63-3-78; 79; 81.
Methow Hatchery Total					**248,183**					

Priest Rapids Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
ST		SU	04/01/01	04/18/01	210,000	4.2	Ringold Springs H	Mid-Columbia River	2000	100% ad+RV clip.
Summer Steelhead Subtotal					**210,000**					
CH	0	FA	06/18/01	06/22/01	2,974,905	45.0	Ringold Springs H	Mid-Columbia River	2000	%ad+CWT; 3k PIT tag.
CH	0	FA	06/11/01	06/20/01	6,862,550	44.6	Priest Rapids H	Mid-Columbia River	2000	200k ad+CWT 63-6-72; 3k PIT tag; 5 rel - 6/11; 13; 15; 17; 19.
Fall Chinook Subyearling Subtotal					**9,837,455**					
Priest Rapids Hatchery Total					**10,047,455**					

Skamania Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
ST		SU	05/01/01	05/04/01	101,844	5.4	Klickitat R	Klickitat River	2000	100% ad clip; Rel - Rm 12-27.
ST		SU	05/09/01	05/09/01	21,632	5.7	Little White Salmon R	Little White Salmon River	2000	100% ad clip; Rel in Drano Lake.
Summer Steelhead Subtotal					**123,476**					
ST		WI	04/30/01	05/06/01	23,858	5.2	White Salmon R	White Salmon River	2000	100% ad clip; Rel at Rm 1.5
Winter Steelhead Subtotal					**23,858**					
Skamania Hatchery Total					**147,334**					

Tucannon Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CH	1	SP	04/01/01	04/25/01	97,600	13.0	Curl Lake	Tucannon River	1999	100% ad+CWT 63-2-75.
Tucannon Total					**97,600**					

Turtle Rock Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CH	0	SU	07/05/01	07/05/01	604,892	40.2	Turtle Rock H	Mid-Columbia River	2000	200k ad+CWT 63-6-71.
CH	0	SU	07/05/01	07/05/01	449,302	27.0	Turtle Rock H	Mid-Columbia River	2000	200k ad+CWT 63-6-67; Accel. growth group.
Summer Chinook Subyearling Subtotal					**1,054,194**					
CH	1	SU	04/17/01	05/27/01	93,281	7.0	Bel. Rocky Reach Dam	Mid-Columbia River	1999	100% ad+CWT 63-4-70+PIT tag; Transf to Chelan PUD for Surv. Sty.
Summer Chinook Yearling Subtotal					**93,281**					
Turtle Rock Hatchery Total					**1,147,475**					

Washougal Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CO	1	NO	04/02/01	04/10/01	1,991,784	20.0	Klickitat R	Klickitat River	1999	50k ad+CWT 63-4-98; 99.
CO	1	SO	04/02/01	04/10/01	810,316	20.0	Klickitat R	Klickitat River	1999	13k ad+CWT 63-4-98; Rel Rm 18-25.
Washougal Hatchery Total					**2,802,100**					

Wells Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	SU	06/20/01	06/21/01	498,500	28.9	Wells H	Mid-Columbia River	2000	100% ad+CWT 63-7-75; 6k PIT tag.
Summer Chinook Subyearling Subtotal					**498,500**					
CH	1	SU	04/16/01	05/07/01	312,098	10.0	Wells H	Mid-Columbia River	1999	100% ad+CWT 63-4-68.
CH	1	SU	04/26/01	05/22/01	113,290	10.0	Bel. Rocky Reach Dam	Mid-Columbia River	1999	100% ad+CWT+PIT; Transf to Grant PUD - Surv Sty; Rel Wan/Priest dams.
Summer Chinook Yearling Subtotal					**425,388**					
ST		SU	04/27/01	05/22/01	116,840	5.5	Methow R	Methow River	2000	100% FB; no ad clip; last load - 14.2k @ 13.5/lb.
ST		SU	04/18/01	05/09/01	228,770	5.9	Okanogan R	Okanogan River	2000	HxH Cross; 100% ad clip;13.8k - Salmon Cr; 19.9k - Omak Cr.
ST		SU	04/27/01	05/22/01	99,490	5.5	Chewuch R	Methow River	2000	HxW Cross; 100% FB w/no ad clip.
ST		SU	04/27/01	05/22/01	109,950	5.5	Twisp R	Methow River	2000	HxW Cross; 100% FB w/no ad clip.
Summer Steelhead Subtotal					**555,050**					
Wells Hatchery Total					**1,478,938**					

WDFW Total	**25,368,377**

Warm Springs Tribe

Blackberry Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	05/14/01	05/14/01	3,377	8.6	Columbia R Above Bonn	Columbia River	1999	Non-Migrators from APds; rel - near Mouth Hood R.
Spring Chinook Yearling Subtotal					**3,377**					
ST		SU	05/15/01	05/15/01	8,828	8.1	Columbia R Above Bonn	Columbia River	2000	Non Migr from APds; Rel - Near Mouth Hood R.
Summer Steelhead Subtotal					**8,828**					
Blackberry Pond Total					**12,205**					

Oak Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		WI	04/30/01	04/30/01	13,265	5.3	E Fk Irrig Dist Sand Trap	Hood River	2000	100% adRV clip.
ST		WI	05/14/01	05/14/01	12,339	5.6	E Fk Irrig Dist Sand Trap	Hood River	2000	100% adRV clip; Acclim 1 week.
ST		WI	04/30/01	04/30/01	14,535	5.6	Parkdale Acclim Pd	Hood River	2000	100% adRV clip; acclim 1 week.
ST		WI	05/14/01	05/14/01	10,740	5.9	Parkdale Acclim Pd	Hood River	2000	100% adRV clip; acclim 1 week; 256 rel - 6/6 at 9/lb (mouth)
Winter Steelhead Subtotal					**50,879**					
ST		SU	04/12/01	04/12/01	11,517	7.2	Blackberry Acclim Pd	Hood River	2000	100% LM clip; 20% adLM clip; acclim 1 week.
ST		SU	04/18/01	04/30/01	17,320	6.7	Blackberry Acclim Pd	Hood River	2000	100% LM clip; 20% ad clip; 5.7k rel - Lake Branch(4/30).
Summer Steelhead Subtotal					**28,837**					
Oak Springs Hatchery Total					**79,716**					

Parkdale Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/04/01	04/04/01	7,066	14.2	Parkdale Acclim Pd	Hood River	1999	100% adRV+CWT 9-32-9; Pilot Study Group.
Parkdale Pond Total					**7,066**					

Round Butte Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	04/04/01	04/04/01	31,319	9.6	Parkdale Acclim Pd	Hood River	1999	100% adRM+CWT 9-31-22.
CH	1	SP	04/04/01	04/23/01	45,005	10.1	Blackberry Acclim Pd	Hood River	1999	100% adLV+CWT 9-31-20; 21.
CH	1	SP	04/04/01	04/23/01	37,873	9.4	Jones Creek Acclim Pd	Hood River	1999	100% adLV+CWT 9-31-20; 21.
Round Butte Total					**114,197**					

Warm Springs Tribe Total	**213,184**

Yakama Tribe

Cascade Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	04/24/01	05/15/01	856,347	18.0	Icicle Cr	Wenatchee River	1999	50% from Eagle Cr H; % marked.
Cascade Total					**856,347**					

Cle Elum Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	05/07/01	05/07/01	116,648	15.0	Cle Elem Slough	Yakama River	1999	100% CWT 5-45-11; 5-49-32; 2.5k PIT tag; Lower Pd.
CO	1	UN	05/24/01	05/24/01	116,740	15.0	Cle Elem Slough	Yakama River	1999	100% CWT 5-45-12; 5-49-33; 2.5k PIT tag; Upper Pd.
Coho Yearling Subtotal					**233,388**					
CH	1	SP	03/15/01	06/06/01	255,751	15.0	Easton Pd	Yakama River	1999	100% ad+CWT 63-4-80;81;84;85;88;89 + RdElast; 13.3k PIT tag.
CH	1	SP	03/15/01	06/06/01	249,499	15.0	Jack Creek Acclim Pd	Yakama River	1999	100% ad+CWT 63-4-82; 83; 86; 87; 92; 93 + OranElast; 13.3k PIT tag.
CH	1	SP	03/15/01	06/06/01	260,536	15.0	Clark Flat Acclim Pd	Yakama River	1998	100% ad+CWT 63-4-90; 91; 94...97 + GreenElast; 13.3k PIT tag.
Spring Chinook Yearling Subtotal					**765,786**					
Cle Elum Hatchery Total					**999,174**					

Eagle Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	04/25/01	05/15/01	260,319	17.8	Winthrop H	Methow River	1999	100% CWT 5-44-32; 33; 5-45-24; Unclipped.
Eagle Creek Subtotal					**260,319**					

Easton Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	05/07/01	05/07/01	118,076	13.0	Easton Pd	Yakama River	1999	100% CWT 5-45-9; 5-43-5; 2.5k PIT tag; Lower Pd.
CO	1	UN	05/24/01	05/24/01	115,000	12.0	Easton Pd	Yakama River	1999	100% CWT 5-45-10; 5-43-6; Upper Pd.
Easton Pond Subtotal					**233,076**					

Klickitat Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	SP	05/08/01	05/08/01	162,500	60.0	Upper Klickitat R	Klickitat River	2000	Unmarked rel group.

Klickitat Subtotal **162,500**

Lost Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	05/07/01	05/07/01	117,322	17.0	Lost Creek Acclim Pd	Yakama River	1999	100% CWT 5-45-8; 5-42-60; 2.5k PIT tag.
CO	1	UN	05/24/01	05/24/01	119,135	17.0	Lost Creek Acclim Pd	Yakama River	1999	100% CWT 5-45-7; 5-42-61; 2.5k PIT tag; Upper pd.

Lost Creek Subtotal **236,457**

Prosser Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	05/06/01	06/05/01	1,699,136	98.8	Prosser Acclim Pd	Yakama River	2000	200k ad+CWT 5-1-3-1-1; Transf from LWhite Salmon H.
CH	0	FA	05/16/01	05/17/01	237,838	64.0	Prosser Acclim Pd	Yakama River	2000	2k PIT tag; 100% Rt Pelvic Clip.
CH	0	FA	04/19/01	04/20/01	189,915	55.0	Prosser Acclim Pd	Yakama River	2000	2k PIT tag; 100% L. Pelvic Clip.
CH	0	FA	04/12/01	04/13/01	12,000	60.0	Yakama R	Yakama River	2000	1k PIT tag; Unmarked rel into Marion Drain.

Prosser Subtotal **2,138,889**

Stiles Pond

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	05/07/01	05/07/01	94,894	15.0	Naches R	Yakama River	1999	100% CWT 5-45-6; 5-42-62; 2.5k PIT tag; Lower Pd.
CO	1	UN	05/24/01	05/24/01	90,337	15.0	Naches R	Yakama River	1999	100% CWT 5-45-5; 5-42-44; 2.5k PIT tag; Upper Pd.

Stiles Pond Subtotal **185,231**

Winthrop Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	04/25/01	04/25/01	146,500	17.0	Methow R	Methow River	1999	100% CWT 5-45-29; No fin clips; Rel in Butcher Cr Acclim Pd.

Winthrop Subtotal **146,500**

Yakama Tribe Total **5,218,493**

Above BONNEVILLE Dam Total **71,029,371**

APPENDIX I

Transportation Proportion Tables

Transportation Proportion in 2001

Proportion of Lower Granite Dam forebay population destined to be transported in 2001.

Model to estimate proportion:

In the transportation proportion estimation procedure, the population of N smolts in Lower Granite Dam forebay is partitioned into X1 fish destined to be transported and X2 fish destined to migrate in-river. The proportion of fish in the transportation category is Pt =X1/N and the proportion of fish in the in-river category is (1-Pt)=X2/N. Below is the derivation of model for springtime migrants with three transportation dams – the procedure for summertime migrants is similar with the addition of a fourth transportation dam (McNary Dam).

$$x2 = (((N*s1-t1)*s2-t2)*s3-t3) = N*s1*s2*s3 - t1*s2*s3 - t2*s3 - t3$$

where s1=survival from origin in Lower Granite Dam forebay to Lower Granite Dam tailrace
s2=survival from Lower Granite Dam tailrace to Little Goose Dam tailrace
s3=survival from Little Goose Dam tailrace to Lower Monumental Dam tailrace
t1=fish removed at Lower Granite Dam for transportation
t2=fish removed at Little Goose Dam for transportation
t3=fish removed at Lower Monumental Dam for transportation

To index x2 back to the starting population in Lower Granite Dam, X2, requires dividing by the survival estimate s1*s2*s3 from Lower Granite Dam forebay to Lower Monumental Dam tailrace.

$$X = x2/(s1*s2*s3) = N - t1/s1 - t2/(s1*s2) - t3/(s1*s2*s3)$$

The number of fish in the starting population destined to be transported then becomes

$$X1 = N-X2 = t1/s1 + t2/(s1*s2) + t3/(s1*s2*s3)$$

The proportion of fish in the starting population destined to be transported is

$$Pt = X1/N = t1/(N*s1) + t2/(N*(s1*s2)) + t3/(N*(s1*s2*s3))$$

The number of fish surviving to the tailrace of each dam is given by the following series of equations:

Lower Granite	$N1 = N*s1$
Little Goose	$N2 = (N1-t1)*s2 = N1*(1-t1/N1)*s2$
Lower Monumental	$N3 = (N2-t2)*s3 = N2*(1-t2/N2)*s3 = N1*(1-t1/N1)*s2*(1-t2/N2)*s3$

Substituting these equalities into the equation for Pt gives

$$Pt = t1/N1 + (1-t1/N1)*t2/N2 + (1-t1/N1)*(1-t2/N2)*t3/N3$$

Letting P1=t1/N1, P2=t2/N2, and P3=t3/N3 the equation for proportion of transport fish in Lower Granite Dam forebay destined for transportation becomes:

$$Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3$$

With McNary Dam transportation added the equation becomes:

$$Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3 + (1-P1)*(1-P2)*(1-P3)*P4$$

where P(J) = transport number / population number
= (transport proportion * collection) / (collection / collection efficiency)
= transport proportion * collection efficiency

The site-specific transport proportions P(J) are based on data from the run-at-large at each dam. These P1, P2, P3, and P4 proportions are computed using facility collection, transport, and population estimates for Lower Granite (J=1), Little Goose (J=2), Lower Monumental (J=3), and McNary (J=4) dams, respectively, and are presented in Tables 1 through 3 for yearling chinook, steelhead , and subyearling chinook, respectively. In 2001, a portion of the springtime migrants were also transported from McNary Dam during a alternating days of full transport and full bypass. The estimate of proportion of each Snake River smolt run "destined for transport" are presented both with and without McNary Dam considered in the model. This allows direct comparison with past years when only three transportation sites are used during the springtime, and a comparison of the amount of transportation added by McNary Dam for fish originating above Lower Granite Dam in 2001. For fish originating in the Mid-Columbia River basin, the transportation proportion is simply estimated by P4 above, and is presented in Tables I-1 to I-3.

The 2001 collection efficiency is estimated using the CSJ mark-recapture model on PIT tagged yearling chinook and steelhead released from the Salmon, Snake and Imnaha River traps in 2001. The 2001 collection efficiency for subyearling chinook was based on estimated FGE's derived from the 2000 release of PIT tagged subyearling chinook at Snake River basin fall chinook acclimation ponds.

TABLE I- 1. Yearling chinook model input data for 2001.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (J=1)	1,958,273	2,500,000	0.000	0.79	0.957	0.756
LGS (J=2)	751,905	1,000,000	0.000	0.78	0.992	0.774
LMN (J=3)	553,434	900,000	0.000	0.65	0.969	0.630
MCN (J=4)	2,226,183	3,000,000	0.032	0.75	0.466	0.350

TABLE I- 2. Steelhead model input data for 2001.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (J=1)	5,580,471	6,300,000	0.000	0.89	0.951	0.846
LGS (J=2)	841,490	1,100,000	0.000	0.77	0.981	0.755
LMN (J=3)	360,382	600,000	0.001	0.64	0.975	0.624
MCN (J=4)	553,432	800,000	0.017	0.69	0.432	0.298

The estimated percent of smolts arriving Lower Granite Dam forebay that were destined for transportation in 2001, including McNary Dam transportation, was approximately 99% for both yearling chinook and steelhead, and 96% for subyearling chinook (Table I-4). For smolts originating in the Mid-Columbia River basin, the estimated percent of smolts arriving McNary Dam fore-bay that were transported was approximately 35% for yearling chinook, 30% for steelhead, and 59% for subyearling chinook.

TABLE I- 3. Subyearling chinook model input data for 2001.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (j=1)	739,851	1,200,000	0.001	0.60	0.995	0.597
LGS (j=2)	178,818	300,000	0.000	0.60	0.955	0.573
LMN (j=3)	53,433	100,000	0.002	0.48	0.982	0.471
MCN (j=4)	10,727,489	17,300,000	0.004	0.62	0.943	0.585

TABLE I- 4. Estimated proportion destined for transportation in 2001.

Species- age group	Transport Proportion		
	Origin Snake R Basin above Lower Granite Dam		Origin Mid-Columbia R Basin
	Without McNary Dam transport	With McNary Dam transport	With McNary Dam transport
Yearling Chinook	0.980	0.987	0.350
Steelhead	0.986	0.990	0.298
Subyearling Chinook	N/A	0.962	0.585

Model without McNary Dam: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3
Model with McNary Dam: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3 + (1-P1)*(1-P2)*(1-P3)*P4
Model for Mid-Columbia R Basin fish: Pt = P4

The proportion of smolts transported in 2001 was higher than in any of the prior three years (Table I-5) due to the extremely low flows projected for the year, and the Federally mandated “energy emergency” operations that required NMFS to implement full transportation at all collector dams in the Snake River basin without spill.

TABLE I- 5. Comparison of the 2001 estimate of the proportion of Snake River Basin smolt population in Lower Granite Dam forebay that are "destined for transportation" and the corresponding estimates from 1998 to 2000. For yearling chinook and steelhead, the 2001 results exclude transport at McNary Dam to mimic conditions in the prior three years.

Species- age group	Transport Proportion[1]			
	2001	2000	1999	1998
Yearling Chinook	0.980	0.71	0.777 (W) 0.862 (H)	0.66-0.81 (W) 0.69-0.77 (H)
Steelhead	0.986	0.81	0.825	0.69-0.83 (W) 0.72-0.85 (H)
Subyearling Chinook	0.962	0.93	0.870	0.91(W)

[1] In years 1999-2001, estimates of collection efficiency based on PIT tag data was used to generate a single annual estimate of proportion transported, while in 1998 assumed levels of high and low FGE and high and low spill effectiveness were used to generate a range for that year's estimate of proportion transported.